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(54) **Remote control system for audio/visual equipment**

Fernbedienung für Video- und Audiogeräte

Système de commande à distance pour des appareils audio/vidéo

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EP 0 624 958 B1

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Description

BACKGROUND

Field of the Invention

[0001] The present invention generally relates to a remote control system. More specifically, the present invention is directed to a remote control system for radio-transmitting a command signal.

Background of the Invention

[0002] Recently, remote control operations are available in various sorts of electronic appliances such as audio/visual appliances, e.g., VTRs, television receivers, and CD players, and also air conditioners, and illumination apparatuses.

[0003] Since users may feel it cumbersome when these various appliances are remote-controlled by employing the remote commanders exclusively designed to the relevant appliances, some methods capable of operating a large number of appliances by way of a single remote controller have been proposed. As one of these single remote commander controlling methods, a central controller is employed.

[0004] In Figure 1, there is shown an example of a remote control system with employment of a central controller. This example is adapted to an A/V (audio/visual) system. The A/V system is so constructed that a VTR 2, a CD player 3, a TV tuner, and an optical video disk player (simply referred to a "video disk player" hereinafter) 5 are connected via an A/V selector amplifier 6 to a CRT monitor 7 and a speaker 8.

[0005] That is, outputs of picture signals SV from the respective VTR 2, TV tuner 4, and video disk player 5 are supplied to a picture input changing unit 6a of an A/V selector amplifier 6 and are selected by the picture input changing unit 6a. Then, the picture signal SV selected by the picture input changing unit 6a is supplied to the CRT monitor 7 to output a picture.

[0006] L-channel and R-channel audio signals (SA_L , SL_R) outputted from the respective appliances of the VTR 2, CD player 3, TV tuner 4, and video disk player 5 are supplied to an audio input changing unit 6b. The, the picture signal selected by the audio input changing unit 6b is amplified by an amplifier unit 6c, and volume controls are performed in the amplifier unit 6c. The resultant audio signals are supplied to an L-channel speaker 8 and a R-channel speaker 8 for outputting sounds.

[0007] Here, there are provided a remote controller "R" equipped with operation keys to operate various appliances in such an A/V system, and a central controller 1 capable of receiving a command signal from this remote commander R. The remote commander R may transmit as an infrared signal by modulating with a predetermined carrier frequency, a command signal read

by an internal microcomputer key of the remote commander R. An infrared ray receiving unit 1a is arranged in correspondence with this remote controller and is capable of receiving an infrared ray signal transmitted from the remote command R.

[0008] The central controller 1 is connected via control signal lines "C" to the VTR 2, CD player 3, TV tuner 4, video disk player 5, A/V selector amplifier 6, and CRT monitor 7, respectively. The respective appliances such as the VTR 2, CD player 3, TV tuner 4, video disk player 5, A/V selector amplifier 6, and CRT monitor 7 can execute operations in response to such command signals which are inputted from the control signal lines "C" and are fetched by system controllers employed in the respective appliances.

[0009] The central controller 1 is arranged as shown in, for instance, Figure 2. That is, an infrared ray signal received by the infrared ray receiving unit 1a is converted into an electric signal, and this electric signal is waveform-shaped and then demodulated to obtain a demodulated signal which will then be supplied as a command signal to a control unit 1b. Reference numeral 1b₁ shows a CPU in the control unit 1b, reference numeral 1b₂ indicates a ROM for storing various sorts of command signals and operation programs, and reference numeral 1b₃ denotes a RAM for storing a command signal and the like, for instance, which is learned by a user. It should be noted that reference numeral 1b₄ indicates a clock oscillator for producing an operation clock of the control unit 1b.

[0010] The CPU 1b₁ of the control unit 1b reads out either one, or a plurality of required command signals from a ROM 1b₂ or a RAM 1b₃ in accordance with the operation program based upon the command signal supplied from the infrared ray receiving unit 1a, and also outputs the read command signals from an output unit 1c to an appliance responding to the command signal. The command signal, or signals outputted from the output unit 1c are supplied via the control signal line C to the respective appliances, so that the respective appliances are operated in accordance with this or these command signals.

[0011] In the A/V system shown in Figure 1, for example, when a user manipulates the fast forward key for VTR 2 by way of the remote commander R during the reproducing operation of the VTR 2, the central controller 1 receives this command signal and outputs a command signal concerning the fast forward operation to the VTR 1 in response to the received command signal, so that this fast forward operation is executed in the VTR 1.

[0012] Also, the central controller 1 may perform various interlocking operation controls in order to simplify user's operation. For instance, CD reproducing play may be enjoyed by merely operating such an operation key indicative of "CD" by way of the remote commander R. That is, upon receipt of the command signal of "CD" transmitted from the remote commander R, the central controller 1 sends a power-ON command to the A/V se-

lector amplifier 6, and further sends such a command signal for changing the audio input changing unit 6b into a CD input terminal. Furthermore, subsequently, the central controller 1 transmits a power-ON command to the CD player 3, and then transmits a CD-reproduction command. Under this control, a CD reproduced sound is produced from the speakers 8.

[0013] As previously explained, when the central controller 1 receives one command signal sent from the remote controller R, the central controller 1 executes a series of control operation with respect to the relevant appliance, so that operations executed by the user may be extremely simplified.

[0014] However, there is a problem that when such a central controller 1 is utilized, the respective appliances must be connected via the control signal lines "C", and thus the system setting operation will become very cumbersome. The connecting operations and modifications in the connecting operations will become troublesome because the number of signal wiring lines among the central controller 1 and the respective appliances is increased.

[0015] Furthermore, to perform connections of such control signal lines, it is, of course, required to employ hardware/software processing arrangements capable of processing the control input terminals corresponding to the respective appliances and the command signals derived from the control input terminals. As a result, there is a limitation that appliances can be utilized in such an A/V system. For instance, there is another problem that none of A/V appliances which are manufactured by different manufactures can be used in such an A/V system.

[0016] To solve these problems, as the method not for requiring the wiring work of the control signal line C, such a method may be conceived that the transmissions of the command signals with employment of infrared rays are performed not only from the remote controller R to the central controller 1, but also from the central controller 1 to the respective appliances.

[0017] However, normally, the transmissions of the command signals by using the infrared rays are carried out by employing the carrier signal having the frequency of on the order of 30 to 60 KHz. As a result, if this transmission method would be executed without any modification, than the infrared command signal transmitted from the remote commander R to the central controller 1 would interfere with the infrared command signal outputted from the central controller 1, resulting in signal interference.

[0018] As a consequence, it is required to temporally shift the transmission of the infrared command signal from the remote commander R to the central controller 1 with respect to the transmission of the infrared command signal from the central controller 1 to the respective appliances. For instance, the central controller 1 should execute such a process for outputting the command signal to the relevant appliance after confirming

that a user releases the operation key of the remote commander R, and no command signal is supplied from the remote commander R.

[0019] However, to execute such a process, the processing operations executed by the microcomputer of the central controller 1 would become cumbersome. There is a problem that a heavy software workload is needed. Furthermore, another large problem occurs. That is, a lengthy time period is required after the user has manipulate the remote commander R until the relevant appliance actually performs the operations in response to this key operation, resulting in deterioration of operation response.

[0020] Documents US-A-5 109 222 and US-A-4 864 647 illustrate examples of known remote control systems using in fared radiation signals to transmit control commands.

SUMMARY OF THE INVENTION

[0021] It is, therefore, an object of the present invention to provide a remote control system which can solve the above-described problems.

[0022] According to the present invention, there is provided a remote control system comprising:

A remote commander for wirelessly transmitting a first command signal in accordance with a user operation, the first command signal being a signal transmission having a first infrared carrier frequency;

control means including a receiving unit for receiving said first command signal at said first infrared carrier frequency transmitted directly to said control means as said signal transmission from said remote commander, and

a transmitting unit, connected to said control means, for wirelessly transmitting a second command signal, directly to a selected appliance, at the same time as said first command signal is transmitted, said second command signal controlling operation of said selected appliance in response to said user operation;

wherein said first and second command signals do not interfere with each other even though wirelessly transmitted through an operational range of common space in the vicinity of said selected appliance, since said second command signal has a second infrared carrier frequency, different from said first infrared carrier frequency.

[0023] Other features of the present invention are mentioned in the appended claims.

[0024] In accordance with the present invention, it is not required to connect the controller with the respective appliances by way of the connection lines (signal ca-

bles). As a result, such a cumbersome control operation setting work is no longer required during the system setting operation. Furthermore, such a limitation that only the appliances connected by the connection lines (signal cables) to each other are controllable can be deprived. Also, in the remote control system of the present invention, interference occurred in the first command signal and the second command signal can be avoided by either differing the first radio transmission medium for transmitting the first command signal from the remote commander to the controller from the second radio transmission medium for transmitting the second command signal outputted from the controller, or by setting the carrier frequencies to such frequencies which do not interfere with each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] For a better understanding of the present invention, reference is made of the detailed description to be read in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic block diagram of a remote control system as a basic idea of the present invention;

Figure 2 is a schematic block diagram of a central controller of the remote control system;

Figure 3 is a schematic block diagram of a remote control system according a first embodiment of the present invention;

Figures 4a and 4b are explanatory diagrams for explaining a central controller of the first embodiment of the present invention, Figure 4a being a schematic block diagram and Figure 4b being represents an example of a signal format of a command signal outputted from the central controller,

Figure 5 is a flow chart for showing a process operation of the central controller;

Figure 6 is an explanatory diagram for indicating an example of an infrared ray transmitting unit of the central controller,

Figure 7 is an explanatory diagram for representing another example of an infrared ray transmitting unit of the central controller;

Figures 8a to 8c are explanatory diagrams for showing transmission directivity of the infrared ray transmitting unit of the central controller represented in Figure 7, Figure 8a indicating transmission directivity as viewed from an upper surface, Figure 8b showing transmission directivity as viewed from a front surface, and Figure 8c denoting transmission directivity as viewed from a side surface;

Figures 9a to 9c indicates an infrared ray receiving unit of an appliance to be controlled, Figure 9a showing an infrared ray receiving unit as viewed from an upper surface, Figure 9b representing an infrared ray receiving unit as viewed from a front

view, and Figure 9c showing an infrared ray receiving unit as viewed from a side surface;

Figure 10 is an explanatory diagram for representing a receiving condition of the infrared receiving unit of the appliance to be controlled shown in Figure 9a to 9c;

Figure 11 is a diagram for explaining a surface condition of a reflection plate;

Figure 12 is an explanatory diagram for explaining another example of an infrared ray receiving unit of an appliance to be controlled;

Figure 13 is a schematic block diagram for showing a remote control system according to a second embodiment of the present invention;

Figure 14 is a schematic block diagram of a remote commander according to the second embodiment of the present invention;

Figure 15 is a schematic block diagram for indicating a central controller according to the second embodiment of the present invention;

Figures 16a to 16j show waveform diagrams used to explain a command transmitting/receiving operation of the second embodiment, Figure 16a representing a command signal SR1 of a remote commander, Figure 16b showing a carrier SR2 of the remote commander, Figure 16c indicating a signal SR3 outputted from an AND gate, Figure 16d denoting an output signal SC1 derived from a band-pass filter of the central controller, Figure 16e showing an output signal SC2 derived from a waveform shaping circuit, Figure 16f representing a waveform of a command signal outputted from a control circuit, Figure 16g indicating a waveform of a carrier outputted from an oscillator; Figure 16h denoting an output signal derived from an AND gate, Figure 16i showing an output signal derived from an bandpass filter of the infrared ray receiving unit of the appliance under control, and Figure 16j indicates a command signal produced after the waveform of the appliance under control has been shaped;

Figure 17 is a schematic block diagram for indicating a central controller according to a third embodiment of the present invention;

Figures 18a and 18b are explanatory diagrams for explaining a remote commander according to the third embodiment of the present invention, Figure 18a showing an outer view of the remote commander, and Figure 18b being a schematic block diagram for indicating the remote commander;

Figure 19 is a flow chart for indicating a process operation of the central controller, and

Figures 20a to 20e are explanatory diagrams for explaining a display operation of a display unit according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0026] Referring now to Figure 3 to Figure 12, a first

embodiment of the present invention will be described.

[0027] Figure 3 represents an arrangement of a remote control system according to this first embodiment. It should be noted that this remote control system is employed in an A/V system similar to that of Figure 1, the same reference numerals are employed as those for denoting the same components of Figure 1, and detailed explanations thereof are omitted.

[0028] Reference numeral 10 denotes a central controller which is arranged so as to be able to receive a command signal from a remote commander RD. The remote commander RD is equipped with operation keys corresponding to various operations executed in various electric appliances. Then, the remote commander RD is so constructed that an internal control unit reads a command signal from either a ROM or a RAM in response to the operation key, this command signal is modulated with a predetermined carrier frequency, for instance, FM-modulated and the modulated command signal may be transmitted as an electromagnetic wave signal.

[0029] In correspondence with the above-described arrangement, an antenna unit 11 is provided on the central controller 10, which can receive the electromagnetic wave signal transmitted from the remote commander RD via this antenna unit 11.

[0030] Also, an infrared ray transmitting unit 12 is provided with the central controller 10. This central controller 10 decodes a command signal issued from the remote commander RD and received by the antenna unit 11, and produces a further command signal used to control various appliances based upon the decoded command signal. Thus the produced command signal is transmitted from the infrared ray transmitting unit 12 as infrared rays.

[0031] As to each of the electric appliances of the VTR 2, the CD player 3, the TV tuner 4, the video disk player 5, the A/V selector amplifier 6, and the CRT monitor 7, an infrared ray receiving unit RJ is provided. Usually, a remote commander exclusively used for each of these electric appliances is provided. These infrared ray receiving units RJ are provided to be able to receive the infrared command signals from the corresponding remote commanders. Each of these electric appliances is so arranged that in response to the command signal inputted from the infrared ray receiving unit and modulated, an internal system controller constructed of a micro-computer can execute a preselected operation control.

[0032] Figure 4a indicates an arrangement of the central controller 10. The signal received by the antenna unit 11 is demodulated by a demodulating unit 13 to derive a pulse as the command signal.

[0033] This command signal is supplied to a control unit 14. In the control unit 14, reference numeral 14a shows a CPU, reference numeral 14b indicates a ROM for holding various command signals and operation programs, reference numeral 14c denotes a RAM for holding a command signal and the like, which are studied by, for instance, a user, and reference numeral 14d

shows a clock oscillator for producing an operation clock of the control unit 14.

[0034] The CPU 14a of the control unit 14 reads either one, or a plurality of predetermined command signals from either the ROM 14b, or the RAM 14c in response to the operation program, and outputs the read command signal, or signals from the infrared ray transmitting unit 12. That is, the command signal as a pulse signal read out from either the ROM 14b, or the RAM 14c is supplied to an AND gate 12a. To the other terminal of the AND gate 12a, a carrier frequency of, for example, 40 KHz is supplied from the oscillator 12b. An output of the AND gate 12a is supplied to a base of a transistor 12c so as to turn ON/OFF another transistor 12c.

[0035] In other words, the transistor 12c is turned ON/OFF in accordance with the command signal which has been modulated by the carrier frequency of 40 KHz.

[0036] During a period where the transistor 12c is turned ON, a current flows through a resistor 12d into a light emitting diode 12e, so that infrared rays are outputted from the light emitting diode. During a period where the transistor 12c is turned OFF, no infrared rays are outputted from the light emitting diode 12e. In accordance with this operation, the command signal modulated with the carrier frequency of 40 KHz is transmitted from the light emitting diode 12e as the infrared ray signal. This command signal has such a format as shown in, for example, Figure 4b. The command signal is constructed of, as represented in Figure 4b, a start recognition pulse portion, a control code, and an identification code. The start recognition pulse unit indicates that the control code starts from which pulse being received after this start recognition pulse portion. The control code is, for instance, 7-bit digital data, and is to control various operations required for various appliances, e.g., reproducing, fast forward, rewind, and stop operations. The identification code is, for example, 5-bit digital data, and is to specify, or identify an appliance to be controlled. Although Figure 4b shows such an identification code whose pulse width is varied by "1" and "0", the present invention is not limited thereto.

[0037] Thus, the infrared ray command signals outputted from the infrared ray transmitting unit 12 are received by the infrared ray receiving units RJ employed in the respective appliance of the VTR 2, CD player 3, TV tuner 4, video disk player 5, A/V selector amplifier 6, and CRT monitor 7.

[0038] Then, the system controller provided in the respective appliances makes a confirmation based upon the identification code that the received command signal is directed to its own system controller, and thereafter performs the operation control instructed by the control data contained in this command signal.

[0039] It should be understood that the format and code system of the command signal differs from manufacturers and models. For example, even when a command of "VTR reproduction" used to a VTR supplied from a manufacture "A" is received by another VTR sup-

plied from another manufacture "B", the latter VTR supplied from the latter manufacture "B" does not perform the reproduction operation.

[0040] To this end, the command signals of plural sorts of format/code systems corresponding to various sorts of manufacturers and models are stored in either the ROM 14b, or the RAM 14c employed in the central controller 10. Then, when an A/V system is installed, a user sets this A/V system in such a manner that command signals adapted to various electric appliances belonging to this A/V system can be outputted from the central controller 10. As a consequence, there is no limitation in using remote-controllable appliances whose format/code systems for command signals are different from those of other manufacturers.

[0041] An example of operations in the central controller 10 will now be explained with reference to a flow chart of Figure 5. It should be noted that in the remote commander RD, various operation keys and various command signals corresponding to these operation keys are prepared, by which various operations such as power ON/OFF, reproduction, record, fast forward, and preset tuning a preselected interlocking operation is executed. It should also be noted that as an operation key to execute the interlocking operation, such keys as "VTR", "CD", "TV", "VDP" are employed.

[0042] Upon receipt of a command signal sent from the remote commander RD, the control unit 14 of the central controller 10 fetches this command signal (F101) and first judges the content of this command signal. In other words, the central controller 10 judges whether the received command signal corresponds to any one of these command signals "VTR", "CD", "TV", and "VDP", or to any other command signals (F102, F103, F104, F105).

[0043] If the received command signal corresponds to none of these command signals "VTR", "CD", "TV", "VDP", but a command signal of each operation unit, then a command signal corresponding to this received signal is read out from the ROM 14b, or the RAM 14c, and is outputted as an infrared signal from the infrared ray transmitting unit 12 (F106).

[0044] For instance, when such a command signal as "VTR reproduction" is transmitted from the remote commander RD, the CPU 14a reads out from either the ROM 14b, or the RAM 14c, a command signal indicative of "VTR reproduction" in the format/code system adapted to the VTR 2 connected as the A/V system, and transmits the latter command signal as an infrared command signal. When this infrared command signal is fetched from the infrared ray receiving unit RJ in the VTR 2, the system controller of the VTR 2 performs the reproducing operation control if the VTR 2 is under power-ON state.

[0045] On the other hand, when such a command signal preset as the interlocking operation of "VTR", "CD", "TV", "VDP" is entered, the CPU 14a will execute the following process operation.

[0046] When the command signal of "VTR" is input-

ted, the CPU 14a first reads out the command signal of power-ON with regard to the A/V selector amplifier 6, and then transmits this command signal (F107). As a result, the A/V selector amplifier 6 is turned ON. Subsequently, a command signal for instructing that the input selecting function to the A/V selector amplifier 6 is read out and then transmitted (F108). Accordingly, the picture input changing unit 6a in the A/V selector amplifier 6 selects the picture signal from the VTR 2, and the audio input changing unit 6b selects the audio signal from the VTR 2.

[0047] Further, subsequently, the CPU 14a reads out another command signal for instructing that the VTR 2 is turned ON, and sends this command signal (F109). Thus, the VTR 2 is turned ON. Next, the CPU 14a reads out another command signal for instructing that the CRT monitor is turned ON, and sends this command signal (F110). As a result, the CRT monitor 7 is turned ON. Finally, the CPU 14a reads out another command signal for instructing the reproducing operation of the VTR 2, and transmits this command signal (F111). Thus, the reproducing operation is performed in the VTR 2. Under this condition, the picture signal SV and the L-channel and R-channel audio signals SA_L , SA_R , which are reproduced in the VTR 2, are supplied via the A/V selector amplifier 6 to the CRT monitor 7 and the speakers 8, so that both the picture and sounds reproduced in the VTR are produced. That is, a series of operations are controlled by merely manipulating the key operation to issue the command signal of "VTR" only one time by the user, whereby he can enjoy the reproduced VTR pictures.

[0048] When the command signal of "CD" is entered, the CPU 14a first reads a command signal for instructing that the A/V selector amplifier 6 is turned ON, and transmits the read command signal (F112). As a result, the A/V selector amplifier 6 is turned ON. Subsequently, the CPU 14a reads out another command signal for instructing that the input selecting function for the A/V selector amplifier 6 is CD, and transmits this read command signal (F113). As a result, the audio input changing unit 6b in the A/V selector amplifier 6 selects the audio signal derived from the CD player 3.

[0049] Further, subsequently, the CPU 14a reads out another command signal for instructing that the CD player 3 is turned ON, and transmits this read command signal (F114). As a consequence, the CD player 3 is turned ON. Then, the CPU 14a finally reads out another command for the reproducing operation of the CD player 3, and transmits the read command signal (F115). Accordingly, the reproducing operation is carried out in the CD player 3. Under this condition, the L-channel and R-channel audio signals SA_L , SA_R reproduced by the CD player 3 are supplied via the A/V selector amplifier 6 to the speaker 8, so that the reproduced sounds are produced.

[0050] When the command signal of "TV" is inputted, the CPU 14a first reads out a command signal for instructing that the A/V selector amplifier 6 is turned ON,

and transmits this command signal (F116). Subsequently, the CPU 14a reads out another command signal for instructing that the input selecting function to the A/V selector amplifier 6 is a TV tuner, and sends this read command signal (F117). At this time, the A/V selector amplifier 6 is turned ON, so that the picture input changing unit 6a and the audio input changing unit 6b in the A/V selector amplifier 6 select the picture signal and the audio signal derived from the TV tuner 4.

[0051] Further, subsequently, the CPU 14a reads out another command signal for instructing that the TV tuner 4 is turned ON, and transmits this read command signal (F118). As a result, the TV tuner 4 is turned ON. Finally, the CPU 14a reads out another command signal for instructing that the CRT monitor 7 is turned ON, and transmits this read command signal (F119). As a consequence, the CRT monitor 7 is turned ON. At this stage, the television picture and audio signals received by the TV tuner 4 are supplied to the CRT monitor 7 and the speaker 8, respectively, whereby the broadcasting program may be observed.

[0052] When the command signal of VDP is entered, the CPU 14a first reads a command signal for instructing that the A/V selector amplifier 6 is turned ON, and sends this command signal (F120). Next, the CPU 14a reads out another command signal for instructing that the input selecting function to the A/V selector amplifier 6 is the video disk player 5, and transmits this read command signal (F121). At this stage, the A/V selector amplifier 6 is turned ON, and the picture input changing unit 6a and the audio input changing unit 6b in the A/V selector amplifier 6 will select the picture signal and the audio signal derived from the video disk player 5.

[0053] Subsequently, the CPU 14a reads out another command signal for instructing that the video disk player 5 is turned ON, and transmits this read command signal (F122). As a result, the video disk player 5 is turned ON. Then, next, the CPU 14a reads out a further command signal for instructing that the CRT monitor 7 is turned ON, and transmits this read command signal (F123). Therefore, the CRT monitor 7 is turned ON.

[0054] Finally, the CPU 14a reads out another command signal for the reproducing operation of the video disk player 5, and transmits this read command signal (F124). At this stage, both the picture signal and the audio signal, which are produced by the video disk player 5, are supplied to the CRT monitor 7 and the speaker 8, thereby outputting pictures and sounds.

[0055] In the remote control system according to the above-described first embodiment, the command signals are transmitted from the remote commander RD as the electromagnetic wave signals to the central controller 10, whereas the command signals by way of the infrared signals are transmitted from the central controller 10 to the respective appliances. As a consequence, the signal transmissions in the two signal systems do not interfere with each other, and therefore, no problem happens to occur even when the signal transmission from

the remote commander R and the signal transmission from the central controller 10 are performed as the same time.

[0056] In other words, in the first embodiment, the central controller 10 need not be connected to the respective electric appliances via the control signal lines, such cumbersome system setting operations are not longer required and further such limitation requirements that only the electric appliances capable of responding the control signals are available can be avoided. As previously explained, in the first embodiment, no interference is produced in the signal transmissions of the two signals systems, and the central controller 10 can immediately transmit the command signals upon receipt of the command signals sent from the remote commander RD. Accordingly, a time period defined between the operation of the remote commander RD by the user and the actual operation of the commanded appliance can be considerably shortened. That is, the operation response can be greatly improved, and the remote control system with high performance can be provided.

[0057] Furthermore, since no wiring connections are required among the central controller 10 and the respective appliances, for instance, these appliances may be positioned at desirable locations within a room. Since this central controller 10 is employed, not only the respective appliances functioning as the A/V system as shown in Figure 3, but also other electric appliances which do not belong to this central controller 10 may be remote-controlled by way of the remote commander RD. For example, an air conditioner, illumination devices and the like, which are installed in the room may be operated in the centerized control manner.

[0058] It should be understood that the above-described electric appliances should be such electric appliances capable of responding to the infrared command signals. If these appliances are capable of responding to the infrared command signals, then the relevant command signals thereto may be stored in the ROM 14b by the central controller 10. Otherwise, a user causes the central controller 10 to perform the learning operation with employment of the remote controller for the air conditioner and the like, and the command signal outputted from the remote commander for the air conditioner and the like may be registered in the RAM 14c.

[0059] On the other hand, the transmissions of the command signals from the central controller 10 to the respective appliances are performed by way of the infrared signals. Therefore, it is preferable to widen infrared transmitting directivity of the central controller 10, and also infrared receiving directivity of each of the electric appliances. This is because a certain limitation is made in the location conditions of the central controller 10 and the respective appliances when both the transmitting directivity and the receiving directivity are not widened.

[0060] Thus, to first widen the transmitting directivity in the central controller 10, for instance, a plurality of

infrared transmitting units 12 are provided on a front surface, both side surfaces, and an upper surface of a housing of an electric appliance, as illustrated in Figure 6. Although not shown in this drawing, these infrared transmitting units 12 may be further provided on a lower surface and a rear surface of this housing. As a consequence, the command signals can be transmitted to the electric appliances along the substantially omnidirectional.

[0061] Alternatively, the directivity may be essentially widened by increasing, to some extent, the output levels of the infrared rays in such a manner that the components of the infrared rays reflected from wall surfaces and furniture of this room can be received at the sufficient signal levels by the respective appliances.

[0062] In general, the infrared ray receiving unit is provided on the front surface of the housing of the respective electronic appliances. Further, there are some possibilities that these electric appliances in such an A/V system as shown in Figure 3 are stacked with each other so as to be installed. In this case, there are similar possibilities that the central controller 10 is stacked on these electric appliances. Accordingly, it is preferable to install the central controller 10 that the infrared rays are emitted from this central controller 10 toward the front panels of the electric appliances which are stacked on either the lower stage of this central controller 10, or the upper stage thereof.

[0063] Thus, it is conceivable that a projection portion 15 is provided on the front surface of the central controller 10, and a large quantity of light emitting diodes 12e are arranged with this projection portion 15. When a knob such as variable resistor is provided with the central controller 10, this knob may be utilized as the projection unit.

[0064] As shown in Figures 8a to 8c in detail, four light emitting diodes 12e are arranged in the projection portion 15 with an interval along the circumference direction, and one light emitting diode 12e is arranged on the front surface. Assuming now that the directivity of each of the light emitting diodes 12e covers a range of +45 degrees to -45 degrees, as shown in a dot and dash line of Figure 8c, the infrared rays can be outputted in an overall range more than 90 degrees with respect to the front surface. As a consequence, the infrared command signal can be effectively irradiated to the front panel of the electric appliance stacked on the upper stage, or the lower stage of the central controller 10.

[0065] On the other hand, as shown in Figures 9a to 9c, the structure of the infrared ray receiving unit RJ in the respective appliances, may be conceived such that a taper-shaped cylindrical reflection plate 18 is fixed on a surface of a light transmitting portion 17 provided at the front surface of a light receiving element 16 in such a manner that a center of an edge portion of this reflection plate 18, which has a smaller diameter, is coincident with a center of the light receiving element 16. As the reflection plate 18, such a structure may be utilized that

a surface of a metal, or a resin is metal-plated.

[0066] If the infrared ray receiving unit RJ is arranged in such a manner, as shown in Figure 10, for instance, when the infrared rays are transmitted from the right direction and in parallel to the housing panel, the infrared rays impinge on the reflection plate 18 and are reflected therefrom, thereby being conducted to the light receiving element 16. Then, an electric signal corresponding to an amount of light detected by the light receiving element 16, is amplified by an amplifier 19, and then the amplified signal is supplied to a demodulating circuit unit, and fetched as a command signal by this unit.

[0067] Now, actually, as shown in Figure 11, since there are formed very fine concaves and convexes on the surface of the reflection plate 18, the infrared rays may cause irregular reflection, so that the irradiation angle thereof would be more or less widened. As a consequence, even if the position and the attitude of the reflection plate 18 would not be fixed at high precision, the infrared command signals could reach the light receiving element 16 with satisfactory condition.

[0068] Even when the central controller 10 would be arranged along the upper and lower directions, or the left and right directions, the infrared command signal transmitted from the central controller 10 could be fetched under satisfactory condition by arranging the above-defined structure.

[0069] When the infrared rays are incident from the front surface, the infrared rays are conducted via the center hole 18b of the reflection plate 18. As a consequence, the infrared command signals outputted when the central controller 10 is arranged on the front surface of the relevant appliance, and the infrared command signals outputted from the remote commander exclusively employed in the relevant appliance may be fetched without any problems.

[0070] It should be noted that such a reflection plate 18 may be mounted by the user, and fixed by him, taking account of various conditions such as positional relationships of the central controller 10.

[0071] As represented in Figure 12, the infrared ray receiving unit RJ employed in each of the electric appliances may employ a reflection plate 20 made of a dome-shaped transparent, or semitransparent molding material. In this case, incident light passes through a point "a", causes irregular reflection at a surface of a point "b", and then reaches the light receiving element 16. Since at the point "b", the reflection plate 20 is transparent, or semitransparent, most of the light components are directly travelled along a straight line. However, a portion of the light components may cause irregular reflection, which will then reach the light receiving element 16. It is of cause that the light emitted from the front direction passes through the reflection plate 20 and then reached the light receiving element 16.

[0072] It should be noted that although the command signals are transmitted from the remote commander RD in the form of electromagnetic waves, whereas the com-

mand signals are transmitted from the central controller 10 in the form of infrared rays in this first embodiment, the infrared ray transmission may be performed on the side of the remote commander RD whereas the electro-magnetic wave transmission may be performed on the side of the central controller. In particular, there is such a merit that substantially no problem may occur in the above-described transmission/reception directivity by transmitting the command signals from the central controller to the respective electronic appliances without using specific means.

[0073] On the other hand, as previously explained in this embodiment, there is an advantage that since the central controller 10 transmits the command signals in the form of infrared rays, the central controller 10 can easily respond to the conventionally employed electric appliances. Namely, most of the presently available electric appliances employ the infrared ray receiving means. It may be conceived that the command signals may be transmitted by using ultrasonic waves instead of infrared rays.

[0074] Referring now to Figure 13 to Figure 16, a second embodiment of the present invention will be described.

[0075] Figure 13 represents an arrangement of a remote control system according to this second embodiment. It should be noted that the same reference numerals shown in Figure 3 are employed as those for indicating the same components, and detailed explanations thereof are omitted.

[0076] Reference numeral 30 indicates a central controller of this embodiment, which is arranged to be able to receive a command signal from a remote commander "R".

[0077] As represented in Figure 14, the remote commander R is equipped with operation keys "K" corresponding to various sorts of operations executed in the various electric appliances. Then, the remote commander "R" is so constructed that a CPU 22a of an internal control unit 22 reads out a command signal from either a ROM, or a RAM in response to the operation keys "K", and outputs this read command signal to an infrared ray transmitting unit 23 so as to be modulated with a predetermine carrier frequency, and transmits the modulated command signal as an infrared signal.

[0078] In the infrared ray transmitting unit 23 of the remote commander R, reference numeral 23a indicates an oscillator for outputting a carrier frequency having, for example, 400 KHz, and this carrier frequency having 400 KHz is supplied to an AND gate 23b. A command signal as a pulse signal from the control unit 22 is supplied to the AND gate 23b as the other input.

[0079] In Figures 16a to 16c, there are represented a carrier frequency SR_2 of 400 KHz from the oscillator 23a, a command signal SR_1 from the controller 22, and an output SR_3 from the AND gate 23b.

[0080] As the output of the AND gate 23b, it becomes a modulated waveform SR_3 shown in Figure 16c which

is produced by modulating the command signal of Figure 16a with the carrier of Figure 16b. This modulated waveform SR_3 is applied to a base of a transistor 23c so as to turn ON/OFF this transistor 23c. That is, the transistor 23c is ON/OFF-controlled based upon the command signal modulated by the carrier frequency of 400 KHz.

[0081] In a time period during which the transistor 23c is turned ON, a current flows through a light emitting diode 23e via a resistor 23d, and infrared rays are outputted from the light emitting diode. In a time period during which the transistor 23c is turned OFF, no infrared rays are outputted from the light emitting diode 23e. In accordance with this operation, the command signal modulated by the carrier frequency of 400 KHz is transmitted from the light emitting diode 23e of a remote commander R as the infrared signal.

[0082] In correspondence with this structure, an infrared ray receiving unit 31 is provided in the central controller 30, as shown in Figure 13, and the infrared signal from the remote controller R can be received by this receiving unit 31.

[0083] Also, an infrared ray transmitting unit 32 is provided in the central controller 30 to produce a command signal based upon the command signal transmitted from the remote controller R in the form of an infrared ray signal. Then, this produced command signal is supplied to the infrared signal transmitting unit 32, and the command signal is transmitting from the transmitting unit 32 as an infrared signal.

[0084] Similar to the respective electric appliances of the first embodiment, an infrared ray receiving unit RJ is provided in each of the electric appliances such as the VTR 2, the CD player 3, the TV tuner 4, the video disk player 5, the A/V selector amplifier 6, and the CRT monitor 7. These electric appliances are so arranged that an internal system controller can execute a predetermined operation control based upon the command signal which has been inputted from the infrared ray receiving unit RJ and demodulated.

[0085] In Figure 15, there is shown an arrangement of the central controller 30. In the infrared ray receiving unit 31, there are provided a light receiving element unit 33 for receiving the infrared rays to output an electric signal in accordance with an amount of the received rays, an amplifier 34 for amplifying the electric signal supplied from the light receiving element unit 33, a band-pass filter 35 whose central frequency has been set to 400 KHz, and a waveform shaping circuit 36.

[0086] The infrared command signal outputted in response to the modulated waveform as shown in Figure 16c is received and detected by the light receiving element unit 33, and is amplified by the amplifier 34. When the amplified command signal is supplied to the band-pass filter 35, the signal component of 400 KHz is extracted by the band-pass filter 35, thereby obtaining a signal SC1 as shown in Figure 16d. Then, this signal SC1 is waveform-shaped by the waveform shaping cir-

cuit 36, and a pulse signal is obtained as a command signal illustrated as a signal SC2 in Figure 16e.

[0087] This command signal is supplied to a controller 37. In the controller 37, reference numeral 37a indicates a CPU, reference numeral 37b denotes a ROM for holding various command signals and operation programs, reference numeral 37c shows a RAM for holding a command signal and the like, which are learned by the user, and reference numeral 37d indicates a clock oscillator for generating an operation clock of the controller 37.

[0088] The CPU 37a of the controller 37 reads out either one, or a plurality of predetermined command signals from the ROM 37b, or the RAM 37c in accordance with the operation program based on the command signal supplied via the waveform shaping circuit 36. The read command signal is supplied to the infrared ray transmitting unit 32, and is transmitted as an infrared signal by the transmitting unit 32.

[0089] The command signal read out from either the ROM 37b, or the RAM 37c is supplied to the AND gate 32a. One example of this command signal waveform SC₃ is shown in Figure 16f.

[0090] To the other terminal of the AND gate 32a, for example, a carrier frequency of 40 KHz is supplied from the oscillator 32b as shown as a signal SC4 of Figure 16g.

[0091] An output of the AND gate 32a is applied to a base of a transistor 32a so as to ON/OFF-control the transistor 32a. In other words, the transistor 32c is ON/OFF-controlled by a modulated waveform SC5 of Figure 16h which is produced by modulating the command signal of Figure 16f with the carrier frequency of 40 KHz of Figure 16g.

[0092] In a time period during which the transistor 32c is turned ON, a current flows through a light emitting diode 32e via a resistor 32d, and infrared rays are outputted from the light emitting diode. In a time period during which the transistor 32c is turned OFF, no infrared rays are outputted from the light emitting diode 32e. In accordance with this operation, the command signal modulated by the carrier frequency of 40 KHz is transmitted from the light emitting diode 32e as the infrared signal.

[0093] Thus, the infrared command signals outputted from the infrared ray transmitting unit 32 are received by the infrared ray receiving unit RJ employed in the respective electric appliances such as the VTR 2, the CD player 3, the TV tuner 4, the video disk player 5, the A/V selector amplifier 6, and the CRT monitor 7. At this time, in case that the carrier corresponds to the infrared command signal with the frequency of 40 KHz in these appliances the infrared command signal based on a waveform of Figure 16h is received by the light receiving element and converted into an electric signal. Thereafter, the resultant signal is processed by the bandpass filter whose central frequency is set to 40 KHz, thereby obtaining a waveform of Figure 16i. Then, this signal is processed by the waveform shaping operation, whereby a pulse signal as shown in Figure 16j functioning as a

command signal can be obtained.

[0094] It should be noted that the output operation example of the command signals in the central controller 30 in response to the command signal from the remote commander R is similar to that of Figure 5, and therefore no further explanation thereof is made in the specification. Also, in case of this embodiment, as to the constructive condition of the infrared transmitting unit 32 employed in the central controller 30 and the constructive condition of the infrared receiving unit RJ employed in the respective appliances, it is preferable to conduct the systems as explained with reference to Figures 8a to 8c through Figure 12.

[0095] In such a remote control system of the second embodiment, the command signal is transmitted from the remote commander R to the central controller 30 in the form of infrared signal, and also the command signals are transmitted from the central controller 30 to the respective electric appliance in the form of infrared signals. It should be understood that the carrier frequency of the infrared signal transmitted from the remote commander R is set to 400 KHz, whereas the carrier frequency of the infrared signal outputted from the controller 30 is set to 40 KHz.

[0096] Then, the command signal is demodulated from the signal component with 400 KHz frequency band by way of the band-pass filter 35 in the central controller 30. In the respective appliances for receiving the infrared command signals transmitted from the central controller 30, the command signals are demodulated from the signal component having 40 KHz frequency band by way of the bandpass filter.

[0097] As a consequence, there is no interference between the transmitted signals in two systems. Also, there is no problem even when the transmission of the command signal from the remote commander R and the transmission of the command signal from the central controller 30 are executed at the same time.

[0098] In other words, similar to the above-explained first embodiment, no connections of the control signal line among the central controller 30 and the respective appliances are required in accordance with the second embodiment. Furthermore, such a cumbersome system setting operation and also such a limitation in using only such electric appliances capable of responding to the control signal lines can be avoided. As previously stated, since there is no interference between the transmitted signals in two systems, the central controller 30 can immediately transmit the command signal in response to the command signal sent from the remote commander R, so that the time period defined since the user operates the remote commander R until the relevant electric appliance is actually operated, can be considerably shortened. That is, the operation response can be greatly improved, and the remote control system with high performance may be provided.

[0099] Also in this case, the location of the central controller 30 may be arbitrarily determined, and opera-

tional controllabilities with respect to various electric appliances may be achieved.

[0100] Although the carrier frequencies of the infrared command signals for the two systems are selected to be 400 KHz and 40 KHz in the second embodiment, the present invention is not limited thereto. Any frequencies are available such that carriers do not interfere with each other and can be separated from each other by way of a bandpass filter under better conditions.

[0101] If the carriers of the command signals from the central controller 30 to the respective appliances are selected to be lower than, or equal to 100 KHz, for instance, on the order of 30 to 60 KHz, since various types of the presently available electric appliances perform the infrared remote controls by setting the carrier frequencies to the above-explained frequency bands, there is a merit that the present invention may be easily applied to these various types of electric appliance.

[0102] On the other hand, the above-described central controllers 10 and 30 may be built within, for example, such an electric appliance as the A/V selector amplifier 6.

[0103] A remote control system for improving operabilities thereof according to a third embodiment of the present invention will now be described with reference to Figures 17 to 20, in which a central controller is built in another electric appliance, and only three sorts ("up", "down", "enter") of command signals are inputted into this central controller, namely, user operates with a remote controller.

[0104] Figures 17 and 18 represent arrangements of the remote control system according to this third embodiment. In this embodiment, the remote control system for A/V appliances is constructed of a remote commander shown in Figure 18, and a central controller 50 built in, for instance, an A/V selector amplifier as indicated in Figure 17.

[0105] As represented in an outer view of Figure 18a and an internal block diagram of Figure 18b, only 3 operation keys of an up-operation key 62, a down-operation key 63, and an enter key 64 are provided on a remote commander 61 as the operation keys.

[0106] Reference numeral 65 indicates a code generator unit which is constructed of, for example, a microcomputer having a CPU and a ROM memory. Then, operation information produced by the up-operation key 62, the down-operation key 63, and the enter key 64 is supplied to the code generator unit 65.

[0107] In correspondence with the respective operation keys 62, 63, 64, an up-operation command signal, a down-operation signal, and an enter command signal have been stored into the ROM memory of the code generating unit 65. Any one of these command signals is read out in response to the supplied operation information, which will then be supplied to a transmitting unit 66. In the transmitting unit 66, a predetermined modulation process is carried out to the supplied command signal, and the resultant command signal is transmitted

to an outside circuit.

[0108] On one hand, in the A/V selector amplifier containing the central controller 50 shown in Figure 17, reference numeral 40 denotes an audio input changing unit for exclusively selecting an audio signal from the audio signals supplied from the VTR 2, the CD player 3, the TV tuner 4, and the video disk player 5, which are connected in such a manner as illustrated in Figure 3 or Figure 13. The audio signal selected by the audio input changing unit 40 is supplied via a volume control unit 41 to an amplifier 42. Then, the amplified audio signal is supplied to the speaker 8, thereby outputting sounds.

[0109] Reference numeral 44 indicates a picture input changing unit for exclusively selecting a picture signal from the picture signals supplied from the VTR 2, the TV tuner 4, and the video disk player 5 connected as described above. The picture signal selected from the picture input changing unit 44 is supplied via a picture changing unit 45 to the CRT monitor 7 connected thereto, thereby outputting a picture.

[0110] In addition to the above-described functional components as the A/V selector amplifier, a central controller 50 is provided which responds to command signals transmitted from the remote commander 61 and being the position designating information about the up-operation, down-operation, and enter keys.

[0111] Reference numeral 51 shows an electromagnetic wave receiving unit for receiving the command signal in the form of electromagnetic wave signal, transmitted from the remote commander 61, to demodulate this received command signal.

[0112] Reference numeral 53 shows a control unit constructed of a microcomputer having a CPU 53a, a ROM 53b, and a RAM 53c. The control unit 53 performs a control as various sorts of remote control system in response to the operation information of the remote commander 61 supplied from the electromagnetic wave receiving unit 51, and also functions as a control unit for the A/V selector amplifier (will be discussed later). That is, the control unit 53 executes the selecting controls of the audio input changing unit 40 and the picture input changing unit 44, the volume control of the volume control unit 41, and the selecting control of the picture changing unit 45 in response to the operation input made by the user.

[0113] Reference numeral 54 shows an operation unit on which various sorts of operation keys are provided, and the operation information derived from the operation unit 54 is supplied to the control unit 53. On the operation unit 54, there are provided function changing keys (54a, 54b, 54c, 54d) used to execute the changing controls of the audio input changing unit 40 and the picture input changing unit 44, and also a picture changing key 54e, an enter key 54g, the up-operation key 54k, the down-operation key 54m and so on, which are to perform the changing control of the picture changing unit 45.

[0114] Reference numeral 55 shows a graphic con-

troller. The graphic controller 55 generates a preselected character picture signal in response to an instruction issued from the control unit 53, superimposes this character picture signal on, for example, a picture signal selected in the picture input changing unit 44, and then supplies the superimposed picture signal via the picture changing unit 45 to the CRT monitor 7. As a display content by a character picture, as illustrated in Figure 20, there are prepared an operation image SD indicative of operation contents, in accordance with various appliances, a representation such as an arrow (will be referred to a "cursor K" hereinafter) representative of a specific operation content among the operation images SD, as a position designation image, and a representation PD of the appliance which is the object of the operation image SD under display. It should also be noted that as to the cursor "K", not only the above-explained arrow, but also other representing means such that, for instance, a frame of an operation image is moved, or color of an indicated operation image is solely changed into another color, may be employed.

[0115] Into the ROM 53b, the RAM 53c of the control unit 53, the control data about the above-explained function components as the A/V selector amplifier, and furthermore, other various command signals with respect to the electric appliances connected to this A/V selector amplifier and other externally provided electric appliances having no relationship with this A/V selector amplifier, have been stored. When one of these command signals is designated by operating the remote commander 61 of the user (will be discussed later), this command signal is read out and supplied to the infrared ray transmitting unit 56.

[0116] In the infrared ray transmitting unit 56, a predetermined modulation process is performed to the supplied command signal, and the modulated command signal is transmitted as an infrared signal to an external appliance. For instance, similar to the above-explained infrared ray transmitting units 12 and 32 employed in the first and second embodiments, the infrared signals are outputted in accordance with the command signal modulated by 40 KHz carrier.

[0117] A basic operation of the remote control system with such a structure will now be explained with reference to Figure 19 and Figure 20.

[0118] Figure 19 is a flow chart for indicating a process operation effected by the control unit 53 based on the position designating information, "up", "down", "enter", transmitted from the remote commander 61, and the operation information produced by the operation unit 54.

[0119] Process operations of any of the function changing keys 54a to 54d in the operation unit 54 will be described later (F201 to F202). First of all, a description will now be made of operations when the operation information is entered by the remote commander 61.

[0120] Here, for example, the user manipulates the picture changing key 54e in the operation unit 54 to

change the picture changing unit 45 from a terminal "T_t" to a terminal "T_g", so that an output of the graphic controller 55 is furnished to the CRT monitor 7, and then a representation as shown in Figure 20a is made. Otherwise, when the user depresses any of the operation keys 62, 63, 64 of the remote commander 61, and the transmitted command signal is received by the infrared ray receiving unit 51, and thereafter fetched into the control unit 53, the picture changing unit 45 is automatically changed from the terminal T_t into the terminal T_g by the control unit 53, so that the output from the graphic controller 55 is supplied to the CRT monitor 7, thereby making a representation as shown in Figure 20a.

[0121] In correspondence with the VTR 2, such operation images as "rewind", "reproduce", "fast forward", "stop", "pause", and "record" are displayed as the operation image SD on the CRT monitor 7. Also, an image of "NEXT" used to change the operation image SD is displayed.

[0122] The command signals about "rewind", "reproduce", "fast forward", "stop", "pause", and "record" in correspondence with the VTR 2 have been stored in the ROM 53b, or the RAM 53c employed in the control unit 53.

[0123] When the up-operation key 62 is depressed in the remote commander 61, and the up-command signal is received and inputted, the control unit 53 controls the graphic controller 55 in order to move up the display position of the cursor K (F203 to F204). Under the condition shown in Figure 20a, for instance, the cursor K indicates the position of the operation image "reproduce", and this cursor K is moved to the position of the operation image "rewind" as indicated by a dotted line. Subsequently, when the up-operation key 62 is depressed, the cursor position is moved from "NEXT" via "record" to "pause" along the up-direction, every time the up-operation key 62 is depressed.

[0124] Also, when the down-operation key 63 is depressed in the remote commander 61, and the down-command signal is received and inputted, the control unit 53 controls the graphic controller 55 to move down the display position of the cursor K (F203 to F205). For example, from such a condition that the cursor K of Figure 20a indicates the position of the operation image "reproduce", the cursor K is moved to the operation image "fast forward". Furthermore, every time the down-operation key 63 is depressed, the cursor position is moved from "stop" via "pause" to "record" along the down direction.

[0125] When the user manipulates the enter key 64 to input the enter command into the control unit 53 under such a condition that the cursor K is moved to a desired position by way of the up-command, or the down-command, the control unit judges whether or not the cursor K presently indicates the position of "NEXT" (F206 to F207). If the present cursor position is the position of "NEXT", then a command signal corresponding to the operation image denoted by the cursor K is read out

from the ROM 53b, or the RAM 53c (F208).

[0126] That is, in the control unit 53, coordinate data corresponding to the display regions of these various operation images displayed on the display screen of the CRT monitor 7 are stored, and furthermore the CPU 53a manages the position of the cursor K moved on this coordinate system in response to the up-command, or the down-command. Then, the control unit 53 judges that the coordinate position presently designated by the cursor K has been designated as the operation content by entering the enter command, and then reads out a command signal which has been stored as the command signal corresponding to this coordinate position.

[0127] Then, for example, when at such a position of the cursor K as indicated by a solid line of Figure 20a, the enter command is inputted, the CPU 53a reads out a command signal indicative of "VTR reproduce" from the ROM 53b, or the RAM 53c, and then supplies the command signal into the infrared ray transmitting unit 56 (F209), whereby this command signal is transmitted as a modulated signal in the form of infrared signal. Thus, the transmitted command signal is received by the VTR 2 positioned around the A/V selector amplifier of Figure 17, and the reproducing operation is performed in this VTR 2 as shown in Figure 3 and Figure 13.

[0128] When the enter command is inputted into the control unit 53 while the cursor K indicates the position of "NEXT", the control unit 53 controls the graphic controller 55 to change the operation image (F207 to F210). For example, in Figure 20a, when the operation image for the VTR is displayed, the screen representation is changed from this operation image into the operation image SD with regard to the video disk player 5 shown in Figure 20b, so that various operation images corresponding to the video disk player 5, such as "leading of previous music head", "leading of succeeding music head", "fast feed", "fast return", "reproduce", "stop", "pause", and also the image of "NEXT" are represented. It is of course that the command signals corresponding to these images have been stored in the ROM 53b, or the RAM 53c in the control unit 53.

[0129] When the cursor K is moved to a predetermined position by way of the up-command, or the down-command on this screen, and the enter command is inputted, a command signal similarly designated with respect to the video disk player 5 is read out by the control unit 53 and is transmitted as an infrared signal.

[0130] Furthermore, the screen representation is changed into the operation image SD for the CD player 3 of Figure 20c by inputting the command of "NEXT", so that various operation images such as "leading of previous music head", "leading of succeeding music head", "fast return", "fast feed", "reproduce", "stop", "pause", and the image of "NEXT" are displayed in response to various operations of the CD player 3.

[0131] If the command "NEXT" is entered from the operation images for the CD player 3, then the present operation images are changed into the operation images

of the channel operation with regard to the TV tuner 4 of Figure 20d. In addition, the command "NEXT" is entered, so that the operation images SD for the A/V selector amplifier as shown in Figure 20e are displayed. Accordingly, the input function changing operation and the images corresponding to the operations of volume up/down are displayed.

[0132] Furthermore, when the command "NEXT" is entered from the image representation of Figure 20e, the images corresponding to the VTR as shown in Figure 20a are returned.

[0133] Here, it should be noted that when any one of these function changing keys 54a to 54d is operated in the operation unit 45, the control unit 53 controls to select the audio input changing unit 40 and the picture input changing unit 44. In this case, the operation images SD are changed into such operation images with regard to the selected appliances (F201 to F202).

[0134] All of the various sorts of command signals used to the various electric appliances which correspond to the respective operation images as shown in Figures 20a to 20e, have been stored into either the ROM 53b, or the RAM 53c. In response to the above-described operations, the command signals corresponding to the operation contents designated by the cursor K are read out, and then are transmitted to either an external electric appliance, or an internal electric appliance (F209).

[0135] It should be noted that as to the operation of Figure 20e, namely either the function change between the audio input changing unit 40 and the picture input changing unit 44, or the volume up/down operation for the volume control unit 41, the control unit 53 directly controls it in the third embodiment. When these are entered, then the control signal pulses generated by the CPU 53a based upon the read command signals are directly supplied to the audio input changing unit 40 and the picture input changing unit 44, or the volume control unit 41.

[0136] In such a remote control system, when the user operates the remote commander 61 to move the cursor K while observing the screen of the CRT monitor 7, and then depresses the enter key 4 at a desired position, various operations can be performed for the various electric appliances. Accordingly, the key operations for the remote commander 61 can be made very simple.

[0137] In particular, the number of operation keys employed in the remote commander 61 is 3 in this case, so that troublesome key operations caused by increasing the number of operation keys can be perfectly solved, and furthermore the key operations can be made simple, because the user can manipulate the operation keys while observing the display screen.

[0138] There is another merit that since the command signal are transmitted from the remote commander 61 in the form of electromagnetic waves, the remote commander 61 is directed toward any directions and held. In addition, a similar effect as in the first and second em-

bodiments can be achieved that since the command signals are outputted from the central controller 50 to the other appliance in the form of infrared rays in a similar manner to that of the first and second embodiments there is no risk of interference.

[0139] It is preferable to control such a remote control system that since the display of the operation image SD during the time other than the operation may become cumbersome, the control unit 53 automatically changes the picture changing unit 45 into the terminal "Tt" unless the command signal is inputted from the remote commander 61 even after the operation by the remote commander 61 has been complete and a preselected time period has elapsed. Also, the representations of the operation images SD and the cursor K may be realized by way of a so-called "child screen system", or a superimposing system.

[0140] Moreover, in case of such a remote control system, the remote commander may output 3 sorts of command signals. For instance, any other remote commanders may be available such that an angular sensor and an acceleration sensor may be employed to detect vibrations of this remote commander by the user in all directions, thereby producing command signals; a mouse may be employed to output a command signal functioning as movement information caused by rotating a track ball, and a shuttle ball may be employed so as to produce such a command signal.

[0141] Also, in this remote control system, the command signals from the remote commander to the central controller 50 may be transmitted in the form of infrared rays. In this case, it is apparent that the carrier frequency of this infrared command signal transmitted from the remote commander is sufficiently separated from that of the infrared command signal outputted from the central controller 50.

[0142] While the various embodiments have been described in the above description, the remote control system of the present invention is not limited to these embodiments, but may be modified without departing from the scope of the present invention, as defined by the appended claims.

Claims

1. A remote control system comprising ;
 - a remote commander (R) for wirelessly transmitting a first command signal in accordance with a user operation, the first command signal being a signal transmission having a first infrared carrier frequency ;
 - control means (30) including a receiving unit (31) for receiving said first command signal at said first infrared carrier frequency transmitted directly to said control means (30) as said signal transmission from said remote commander (R), and
 - a transmitting unit (32), connected to said

control means (30), for wirelessly transmitting a second command signal, directly to a selected appliance, at the same time as said first command signal is transmitted, said second command signal controlling operation of said selected appliance in response to said user operation ;

wherein said first and second command signals do not interfere with each other even though wirelessly transmitted through an operational range of common space in the vicinity of said selected appliance, since said second command signal has a second infrared carrier frequency, different from said first infrared carrier frequency.

2. A remote control system as claimed in claim 1, wherein one of the first and second carrier frequencies is no greater than 100 kHz.

3. A remote control system as claimed in claim 1 or claim 2 further comprising :

A display (7) connected to said control means (30) for indicating an electronic appliance designated in accordance with said user operation.

4. A remote control system as claimed in anyone of claims 1 to 3, wherein said transmitting unit (12;32) transmits said second command signal along various mutually different directions.
5. A remote control system as claimed in anyone of claims 1 to 3, wherein first and second transmitting units (12) are located on different surfaces of the control means (30).
6. A remote control system as claimed in anyone of claims 1 to 3, wherein said transmitting unit (12;32) comprises one or more transmitters (12e) disposed at an angle to each other.
7. A remote control system as claimed in anyone of claims 1 to 3, wherein said transmitting unit (12;32) comprises at least three, orthogonally arranged transmitters (12e).
8. A remote control system as claimed in anyone of claims 1 to 3, further comprising a reflection plate (18;20) for directing the second command signal to a receiving unit (RJ) on the selected appliance.
9. A remote control system as claimed in claim 8, wherein the reflection plate (18) comprises a taper-shaped cylindrical reflection plate.
10. A remote control system as claimed in claim 8, wherein the reflection plate (20) comprises a dome-shaped reflection plate.

11. A remote control system as claimed in claim 8, wherein the reflection plate (18) includes an irregular surface for dispersing the second command signal.

12. A remote control system as claimed in anyone of claims 1 to 11, further comprising:

a graphics controller (55) responsive to said first command signal for:

superimposing an image (SD) on a display (7), the image (SD) indicating a plurality of appliances which can be selected, superimposing a cursor (K) on the display, and superimposing an image (SD) on said display indicating a plurality of available commands for a selected appliance (PD).

13. A remote control system as claimed in claim 12, wherein said cursor (K) moves in response to said first command signal to indicate either one of said plurality of appliances or one of said plurality of available commands so that said indicated appliance or command can be selected in response to a user operation.

14. A remote control system as claimed in claim 1, wherein said selected appliance is an air conditioner.

15. A remote control system as claimed in claim 1, wherein said transmitting unit (32) transmits said second command signal using non-visible light.

16. A remote control system as claimed in anyone of claims 1 to 15, wherein said receiving unit (31) of said control means (30) comprises a band pass filter (35) for passing only signals of said first carrier frequency.

17. A remote control system as claimed in anyone of claims 1 to 16, wherein said control means (30) further comprises memory (37b, 37c), storing a set of stored command signals of a plurality of code and format systems, each of said code and format systems being categorized according to respective individual appliances manufactured by a plurality of manufacturers.

18. A remote control system as claimed in claim 17, wherein said memory (37b) is a ROM.

19. A remote control system as claimed in claim 17, wherein said memory (37c) is a RAM, and wherein stored command signals for code and format systems, additional to said stored command signals,

according to additional appliances, are output from a corresponding remote commander (R) and registered into the RAM (37c) using a learning operation.

20. A remote control system according to anyone for claims 1 to 19, **characterized in that** it further comprises :

a speaker (8) and a video monitor (7), a selecting apparatus (6) having a receiving unit (RJ) for receiving the second command signal, said selecting apparatus (6) being connected among a plurality of appliances (2,3,4,5), each of which output at least one of an audio or video signal, said selecting apparatus (6) selectively supplying a signal or signals from one of said plurality of appliances (2,3,4,5) to said speaker (8) or video monitor (7) in response to said second command signal.

21. A remote control system as claimed in claim 20, wherein said selecting apparatus (6) and said selected appliance are both controlled by said second command signal in response to a single user operation.

Patentansprüche

1. Fernsteuersystem

mit einer Fernsteuerung (R) zum drahtlosen Senden eines ersten Befehlssignals entsprechend einer Benutzerbetätigung, wobei das erste Befehlssignal eine Signalübertragung mit einer ersten Infrarot-Trägerfrequenz darstellt, mit einer Steuereinrichtung (30), die eine Empfangseinheit (31) zum Empfangen des ersten Befehlssignals auf der ersten Infrarot-Trägerfrequenz enthält, das von der Fernsteuerung (R) als die genannte Signalübertragung direkt zu der Steuereinrichtung (30) gesendet wird, sowie mit einer mit der Steuereinrichtung (30) verbundenen Sendeeinheit (32) zum drahtlosen Senden eines zweiten Befehlssignals direkt zu einem ausgewählten Gerät zu der gleichen Zeit, in der das erste Befehlssignal gesendet wird, wobei das zweite Befehlssignal die Funktion des ausgewählten Geräts entsprechend der Benutzerbetätigung steuert,

wobei das erste und das zweite Befehlssignal nicht miteinander interferieren, selbst wenn sie drahtlos durch einen Betriebsbereich eines gemeinsamen Raums in der Nähe des ausgewählten Geräts übertragen werden, da das zweite Befehls-

- signal eine zweite Infrarot-Trägerfrequenz hat, die sich von der ersten Infrarot-Trägerfrequenz unterscheidet.
2. Fernsteuersystem nach Anspruch 1, bei dem von der ersten und der zweiten Trägerfrequenz eine nicht größer ist als 100 kHz. 5
 3. Fernsteuersystem nach Anspruch 1 oder 2, ferner mit 10

einem mit der Steuereinrichtung (30) verbundenen Display (7) zum Anzeigen eines elektronischen Geräts, das entsprechend der Benutzerbetätigung festgelegt wird. 15
 4. Fernsteuersystem nach einem der Ansprüche 1 bis 3, bei dem die Sendeeinheit (12; 32) das zweite Befehlssignal in mehreren Richtungen aussendet, die sich voneinander unterscheiden. 20
 5. Fernsteuersystem nach einem der Ansprüche 1 bis 3, bei dem eine erste und eine zweite Sendeeinheit (12) an verschiedenen Flächen der Steuereinrichtung (30) angeordnet sind. 25
 6. Fernsteuersystem nach einem der Ansprüche 1 bis 3, bei dem die Sendeeinheit (12; 32) einen oder mehrere Sender (12e) umfaßt, die im Winkel zueinander angeordnet sind. 30
 7. Fernsteuersystem nach einem der Ansprüche 1 bis 3, bei dem die Sendeeinheit (12; 32) wenigstens drei orthogonal angeordnete Sender (12e) umfaßt. 35
 8. Fernsteuersystem nach einem der Ansprüche 1 bis 3, ferner mit einer Reflexionsscheibe (18; 20) zum Umlenken des zweiten Befehlssignals zu einer Empfangseinheit (RJ) an dem ausgewählten Gerät. 40
 9. Fernsteuersystem nach Anspruch 8, bei dem die Reflexionsscheibe (18) eine kegelförmige zylindrische Reflexionsscheibe aufweist.
 10. Fernsteuersystem nach Anspruch 8, bei dem Reflexionsscheibe (20) eine kuppelförmige Reflexionsscheibe aufweist. 45
 11. Fernsteuersystem nach Anspruch 8, bei dem die Reflexionsscheibe (18) eine unregelmäßige Fläche zum Streuen des zweiten Befehlssignals aufweist. 50
 12. Fernsteuersystem nach einem der Ansprüche 1 bis 11, ferner mit 55

einer auf erste Befehlssignal ansprechenden Graphiksteuerung (55) zum:

Überlagern eines Bilds (SD) auf einem Display
 - (7), wobei das Bild (SD) eine Mehrzahl von Geräten anzeigt, die zur Auswahl stehen, Überlagern eines Cursors (K) auf dem Display und Überlagern eines Bilds (SD) auf dem Display, das mehrere Befehle anzeigt, die für ein ausgewähltes Gerät zur Verfügung stehen.
 13. Fernsteuersystem nach Anspruch 12, bei dem der Cursor (K) sich in Abhängigkeit von dem ersten Befehlssignal bewegt, um entweder eines aus der Mehrzahl von Geräten oder einen aus der Mehrzahl der zur Verfügung stehenden Befehle anzuzeigen, so daß das angezeigte Gerät oder der angezeigte Befehl entsprechend einer Benutzerbetätigung ausgewählt werden können.
 14. Fernsteuersystem nach Anspruch 1, bei dem das ausgewählte Gerät eine Klimaanlage ist.
 15. Fernsteuersystem nach Anspruch 1, bei dem die Sendeeinheit (32) das zweite Befehlssignal unter Verwendung von unsichtbarem Licht sendet.
 16. Fernsteuersystem nach einem der Ansprüche 1 bis 15, bei dem die Empfangseinheit (31) der Steuereinrichtung (30) ein Bandpaßfilter (35) aufweist, das nur für Signale mit der ersten Trägerfrequenz durchlässig ist.
 17. Fernsteuersystem nach einem der Ansprüche 1 bis 16, bei dem die Steuereinrichtung (30) ferner einen Speicher (37b, 37c) aufweist, der einen Satz von gespeicherten Befehlssignalen von mehreren Code- und Formatsystemen speichert, wobei jedes dieser Code- und Formatsysteme nach individuellen Geräten kategorisiert ist, die von mehreren Herstellern hergestellt werden.
 18. Fernsteuersystem nach Anspruch 17, bei dem der Speicher (37b) ein ROM ist.
 19. Fernsteuersystem nach Anspruch 17, bei dem der Speicher (37c) ein RAM ist und bei dem zusätzlich zu den gespeicherten Befehlssignalen ferner gespeicherte Befehlssignale für Code- und Formatsysteme, die zusätzlichen Geräten entsprechen, von einer entsprechenden Fernsteuerung (R) ausgegeben und mit Hilfe eines Lernvorgangs in dem RAM registriert werden
 20. Fernsteuersystem nach einem der Ansprüche 1 bis 19,

dadurch gekennzeichnet, daß es ferner aufweist:

einen Lautsprecher (8) und einen Videomonitor (7),

ein Auswahlgerät (6) mit einer Empfangseinheit (RJ) zum Empfangen des zweiten Befehlssignals,

wobei das Auswahlgerät zwischen einer Mehrzahl von Geräten (2, 3, 4, 5) angeordnet ist, die jeweils ein Audio- und ein Videosignal oder wenigstens eine dieser Signalarten ausgeben, und

wobei das Auswahlgerät (6) in Abhängigkeit von dem zweiten Befehlssignal selektiv dem Lautsprecher (8) oder dem Videomonitor (7) ein Signal bzw. Signale aus der Mehrzahl von Geräten (2, 3, 4, 5) zuführt.

21. Fernsteuersystem nach Anspruch 20, bei dem sowohl das Auswahlgerät (6) als auch das ausgewählte Gerät durch das zweite Befehlssignal in Abhängigkeit von einer einzigen Benutzerbetätigung gesteuert werden.

Revendications

1. Système de commande à distance comprenant :

une commande à distance (R) destinée à émettre sans fil un premier signal d'ordre conformément à un actionnement d'un utilisateur, le premier signal d'ordre étant une émission d'un signal présentant une première fréquence porteuse infrarouge,

un moyen de commande (30) comprenant une unité de réception (31) destinée à recevoir ledit premier signal d'ordre à ladite première fréquence porteuse infrarouge transmis directement audit moyen de commande (30) en tant que dite émission de signal depuis ladite commande à distance (R), et

une unité d'émission (32), reliée audit moyen de commande (30), afin d'émettre sans fil un second signal d'ordre, directement vers un appareil sélectionné, en même temps que ledit premier signal d'ordre est émis, ledit second signal d'ordre commandant le fonctionnement dudit appareil sélectionné en réponse audit actionnement de l'utilisateur,

dans lequel lesdits premier et second signaux d'ordres n'interfèrent pas l'un avec l'autre même s'ils sont émis sans fil dans une portée fonctionnelle d'un espace commun à proximité dudit appareil sélectionné, du fait que ledit second signal d'ordre présente une seconde fréquence porteuse infrarouge, différente de ladite première fréquence porteuse infrarouge.

2. Système de commande à distance selon la revendication 1, dans lequel l'une des première et secon-

de fréquences porteuses n'est pas supérieure à 100 kHz.

3. Système de commande à distance selon la revendication 1 ou la revendication 2, comprenant en outre :

un dispositif d'affichage (7) relié audit moyen de commande (30) afin d'indiquer un appareil électronique désigné conformément audit actionnement de l'utilisateur.

4. Système de commande à distance selon l'une quelconque des revendications 1 à 3, dans lequel ladite unité d'émission (12 ; 32) émet ledit second signal d'ordre suivant diverses directions mutuellement différentes.

5. Système de commande à distance selon l'une quelconque des revendications 1 à 3, dans lequel des première et seconde unités d'émission (12) sont localisées sur des surfaces différentes du moyen de commande (30).

6. Système de commande à distance selon l'une quelconque des revendications 1 à 3, dans lequel ladite unité d'émission (12 ; 32) comprend un ou plusieurs émetteurs (12) disposés à un certain angle les uns par rapport aux autres.

7. Système de commande à distance selon l'une quelconque des revendications 1 à 3, dans lequel ladite unité d'émission (12 ; 32) comprend au moins trois émetteurs agencés orthogonalement (12e).

8. Système de commande à distance selon l'une quelconque des revendications 1 à 3, comprenant en outre une plaque de réflexion (18 ; 20) destinée à orienter le second signal d'ordre vers une unité de réception (RJ) de l'appareil sélectionné.

9. Système de commande à distance selon la revendication 8, dans lequel la plaque de réflexion (18) comprend une plaque de réflexion cylindrique en forme de cône.

10. Système de commande à distance selon la revendication 8, dans lequel la plaque de réflexion (20) comprend une plaque de réflexion en forme de dôme.

11. Système de commande à distance selon la revendication 8, dans lequel la plaque de réflexion (18) comprend une surface irrégulière en vue de disperser le second signal d'ordre.

12. Système de commande à distance selon l'une quelconque des revendications 1 à 11, comprenant en

outre :

un contrôleur graphique (55) sensible au premier signal d'ordre afin de :

superposer une image (SD) sur un dispositif d'affichage (7), l'image (SD) indiquant une pluralité d'appareils qui peuvent être sélectionnés,
superposer un curseur (K) sur le dispositif d'affichage, et
superposer une image (SD) sur ledit dispositif d'affichage indiquant une pluralité d'ordres disponibles pour un appareil sélectionné (PD).

13. Système de commande à distance selon la revendication 12, dans lequel ledit curseur (K) se déplace en réponse audit premier signal d'ordre afin d'indiquer l'un ou l'autre appareil de ladite pluralité d'appareils ou bien un ordre de ladite pluralité d'ordres disponibles de sorte que ledit appareil indiqué ou l'ordre peut être sélectionné en réponse à un actionnement de l'utilisateur.
14. Système de commande à distance selon la revendication 1, dans lequel ledit appareil sélectionné est un conditionneur d'air.
15. Système de commande à distance selon la revendication 1, dans lequel ladite unité d'émission (32) émet ledit second signal d'ordre en utilisant de la lumière non visible.
16. Système de commande à distance selon l'une quelconque des revendications 1 à 15, dans lequel ladite unité de réception (31) dudit moyen de commande (30) comprend un filtre passe-bande (35) destiné à ne laisser passer que des signaux de ladite première fréquence porteuse.
17. Système de commande à distance selon l'une quelconque des revendications 1 à 16, dans lequel ledit moyen de commande (30) comprend en outre une mémoire (37b, 37c), mémorisant un ensemble de signaux d'ordres mémorisés d'une pluralité de systèmes de codage et de formatage, chacun desdits systèmes de codage et de formatage étant classé par catégorie conformément aux appareils individuels respectifs fabriqués par une pluralité de fabricants.
18. Système de commande à distance selon la revendication 17, dans lequel ladite mémoire (37b) est une mémoire morte.
19. Système de commande à distance selon la revendication 17, dans lequel ladite mémoire (37c) est

une mémoire vive, et dans lequel les signaux d'ordres mémorisés pour des systèmes de codage et de formatage, en plus desdits signaux d'ordres mémorisés, conformément aux appareils supplémentaires, sont fournis en sortie depuis une commande à distance correspondante (R) et sont enregistrés dans la mémoire vive (37c) en utilisant une opération d'apprentissage.

20. Système de commande à distance selon l'une quelconque des revendications 1 à 19, **caractérisé en ce qu'il** comprend en outre :

un haut-parleur (8) et un moniteur vidéo (7),
un dispositif de sélection (6) comportant une unité de réception (RJ) destinée à recevoir le second signal d'ordre,
ledit dispositif de sélection (6) étant relié entre une pluralité d'appareils (2, 3, 4, 5), dont chacun fournit en sortie au moins l'un d'un signal audio ou d'un signal vidéo,
ledit dispositif de sélection (6) fournissant sélectivement un signal ou des signaux à partir d'un appareil de ladite pluralité d'appareils (2, 3, 4, 5) audit haut-parleur (8) ou au moniteur vidéo (7) en réponse audit second signal d'ordre.

21. Système de commande à distance selon la revendication 20, dans lequel ledit dispositif de sélection (6) et ledit appareil sélectionné sont tous deux commandés par ledit second signal d'ordre en réponse à un seul actionnement de l'utilisateur.

FIG. 1

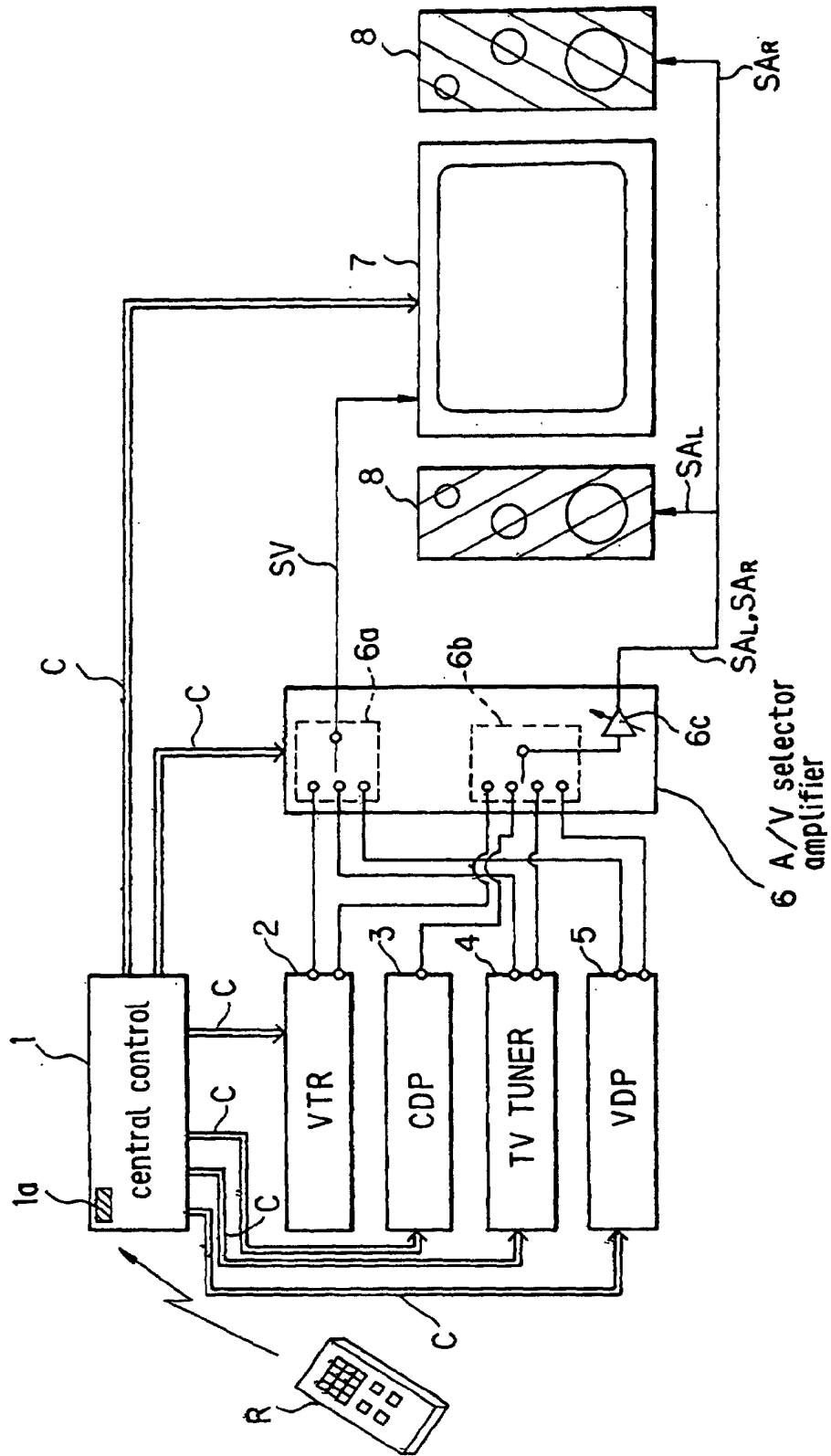


FIG. 2

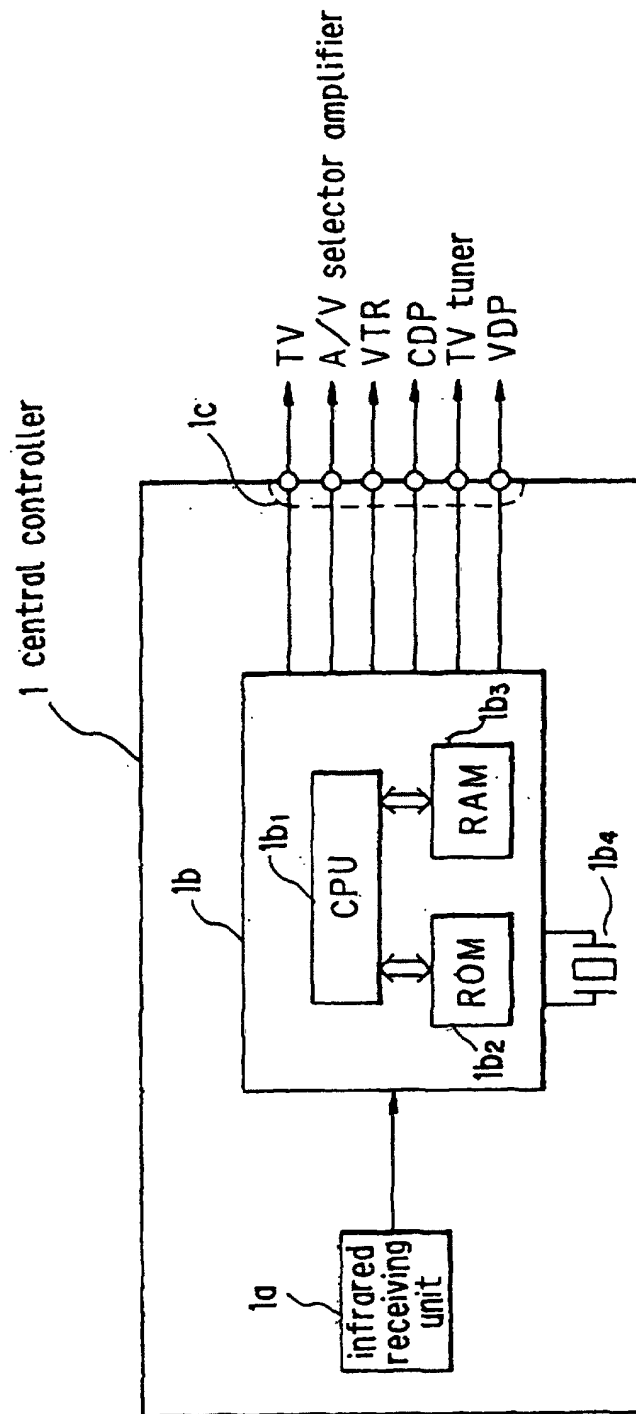


FIG. 3

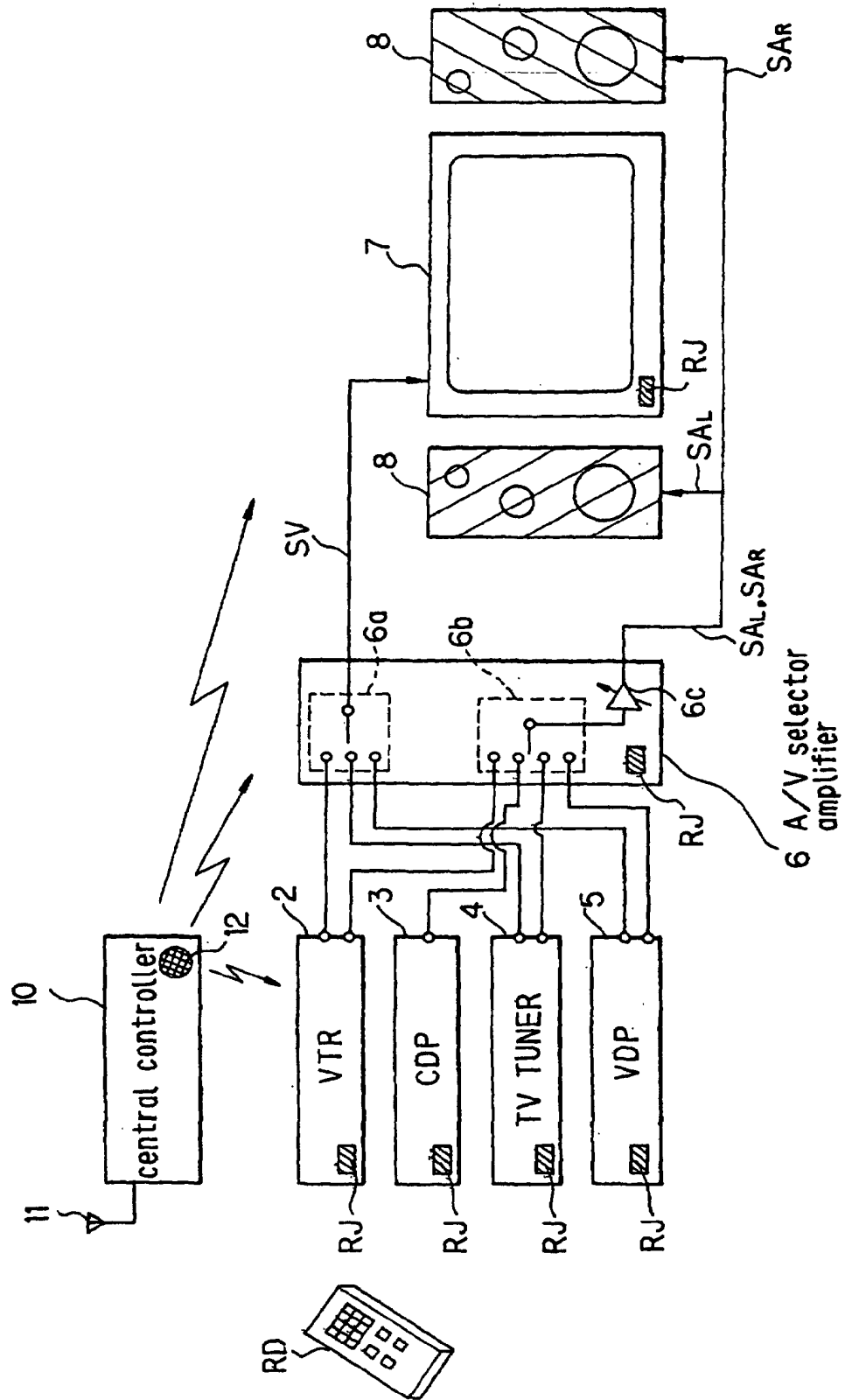


FIG. 4A

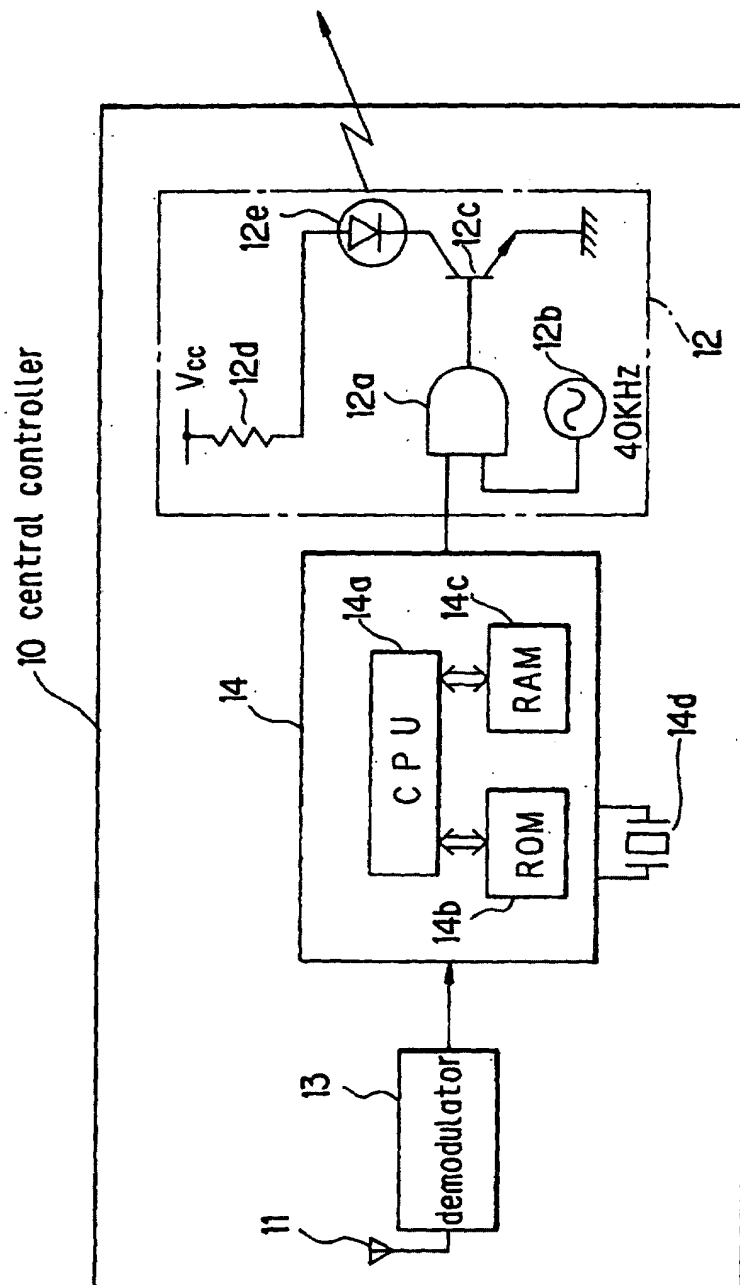


FIG. 4B

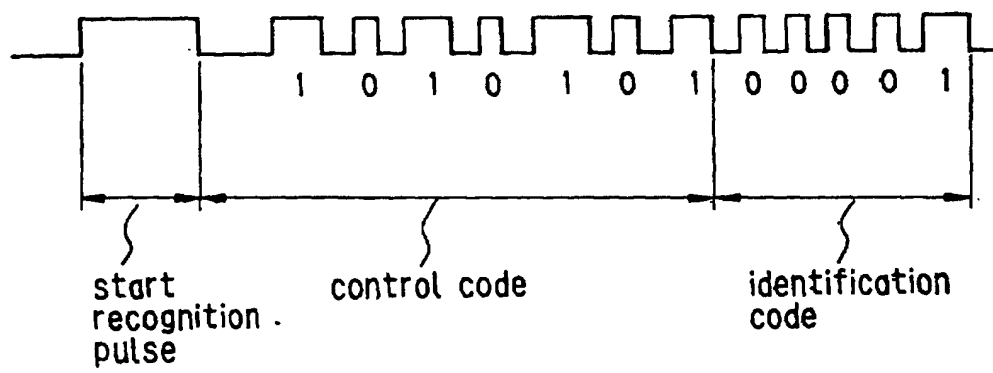


FIG. 5

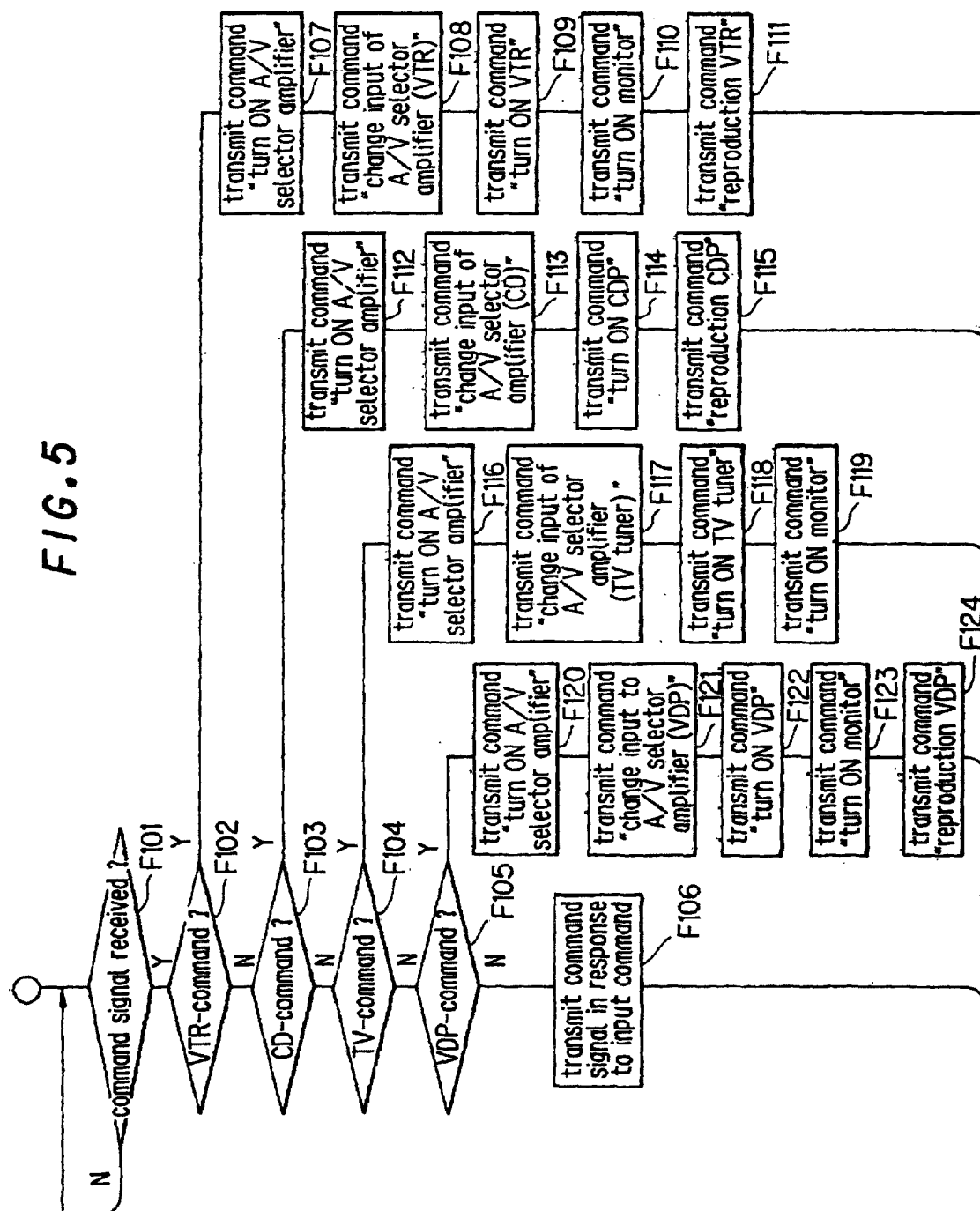


FIG. 6

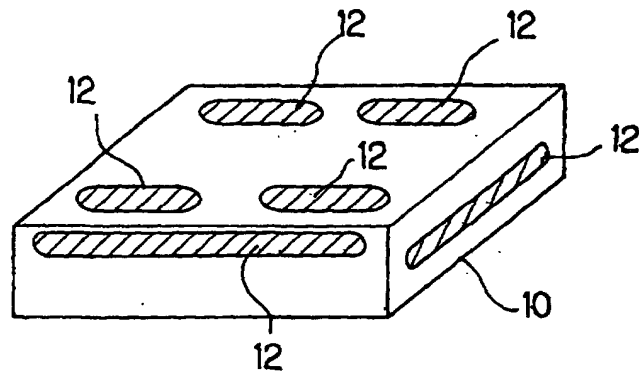


FIG. 7

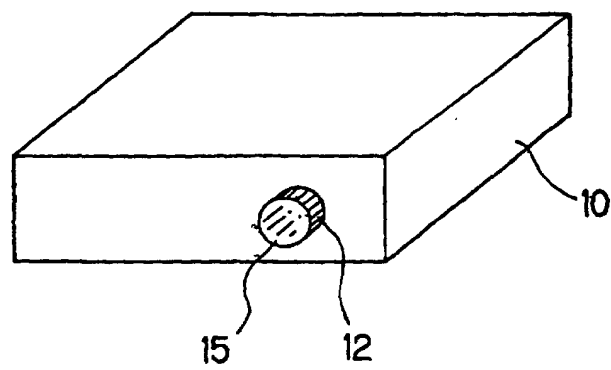


FIG. 8A

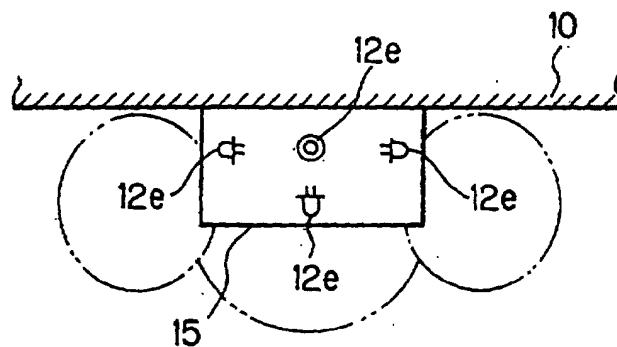


FIG. 8B

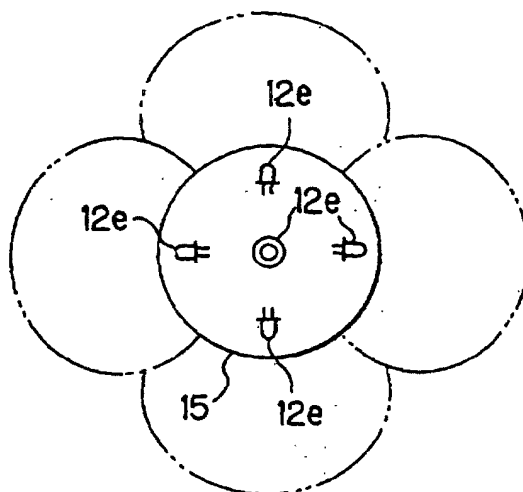


FIG. 8C

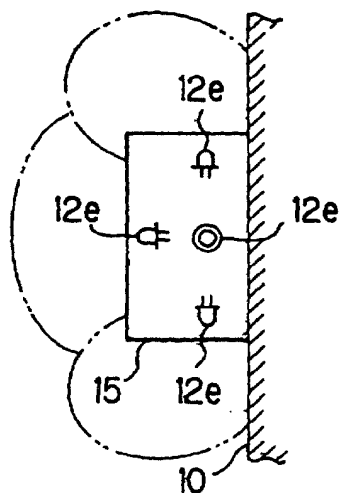


FIG. 9A

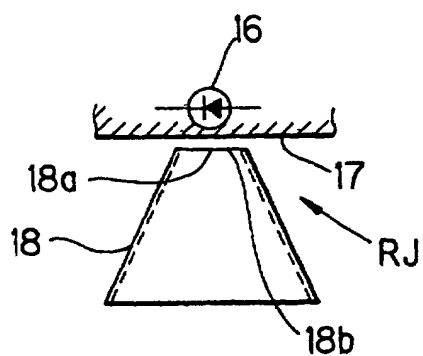


FIG. 9B

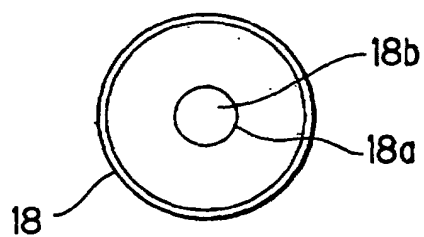


FIG. 9C

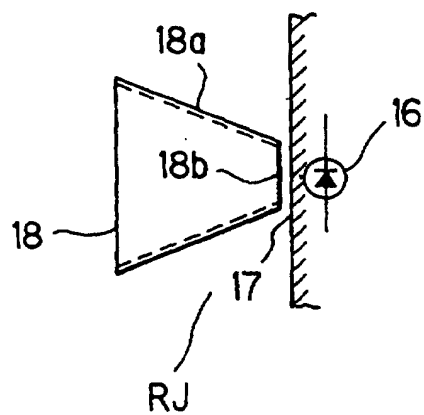


FIG. 10

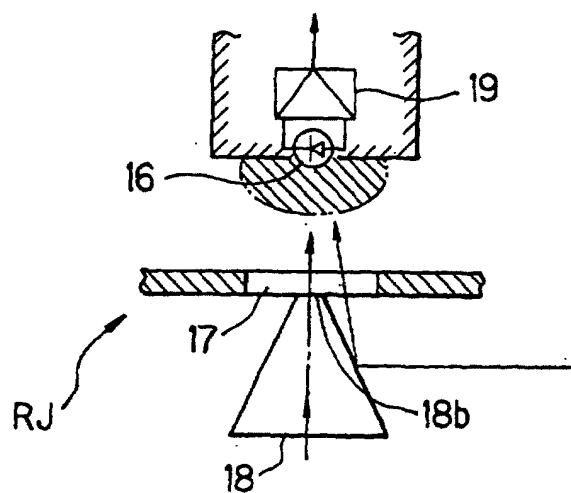


FIG. 11

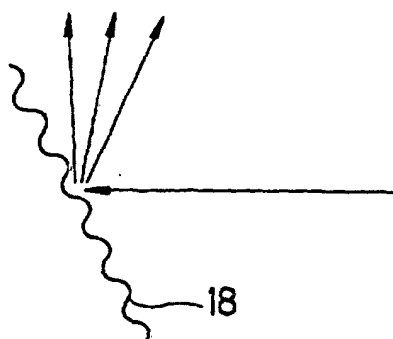


FIG. 12

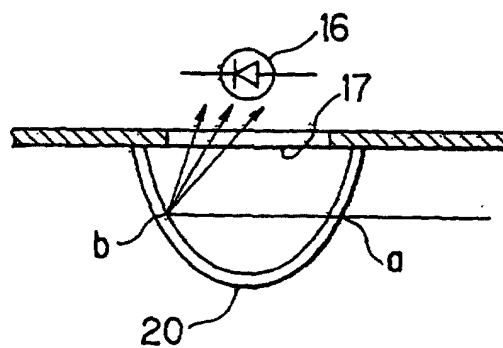


FIG. 13

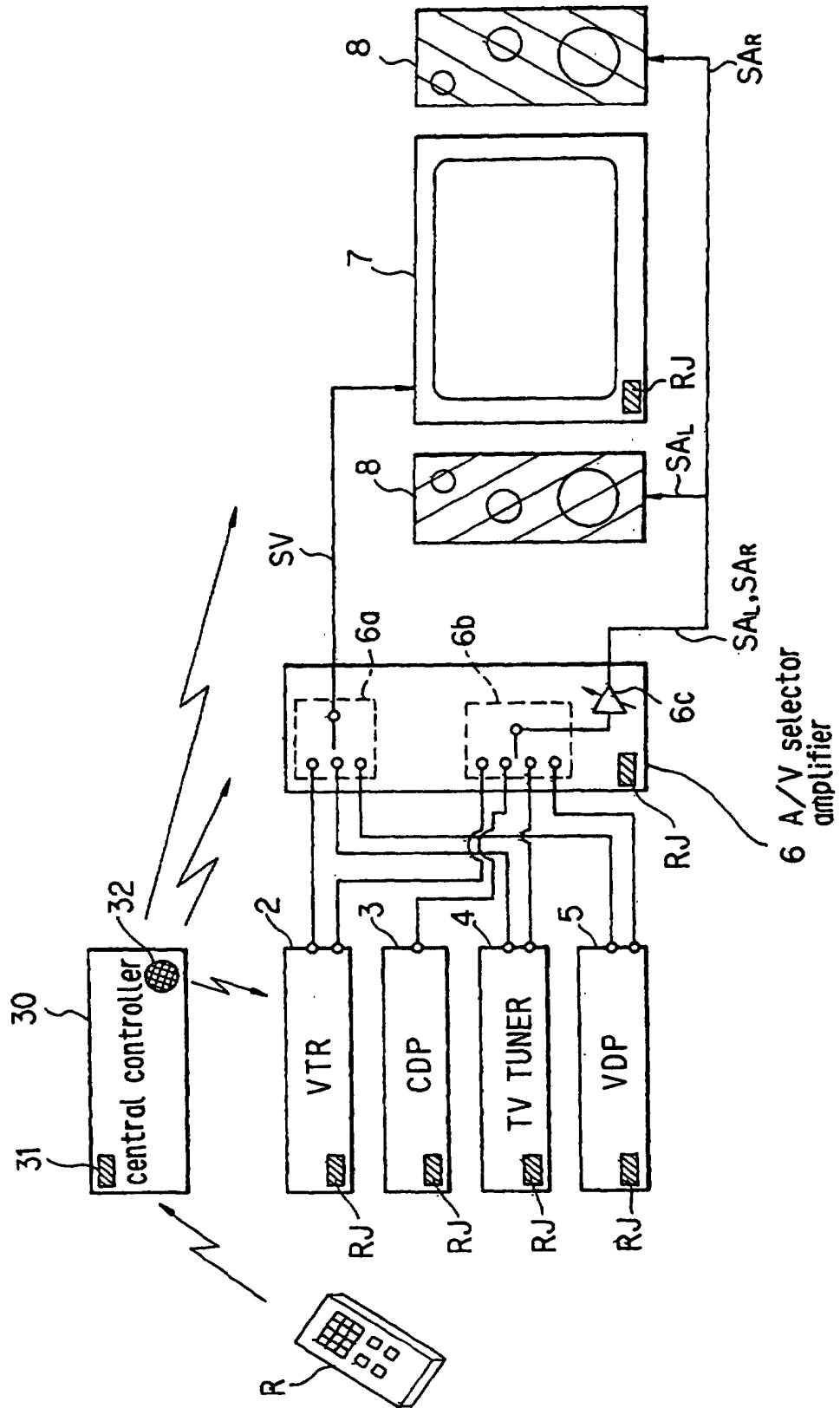


FIG. 14

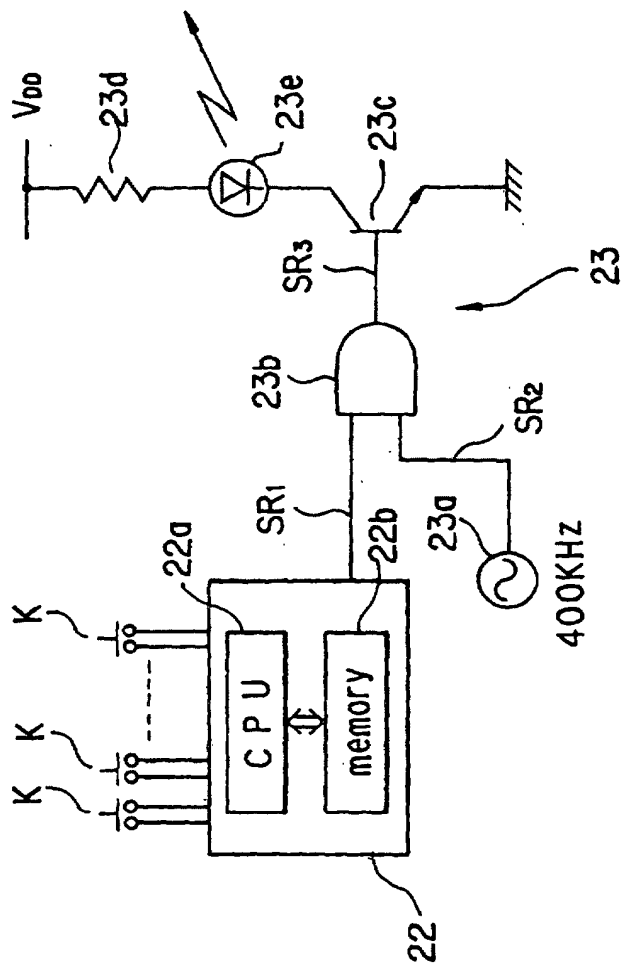


FIG. 15

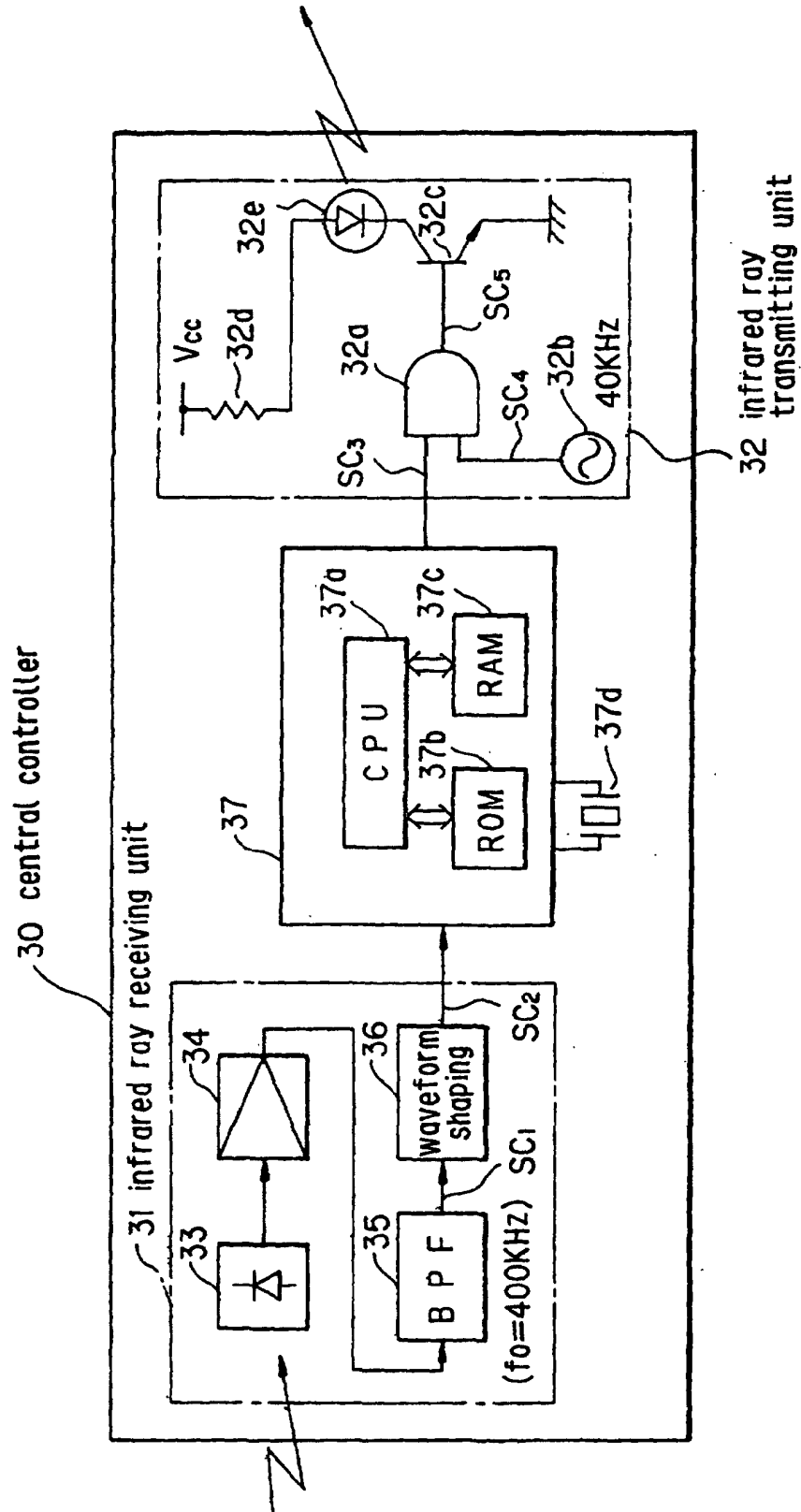


FIG. 16A

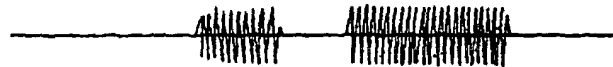
comand waveform

SR₁**FIG. 16B**

400KHz carrier

SR₂**FIG. 16C**

modulated waveform

SR₃**FIG. 16D**BPF output
(f₀=400KHz)SC₁**FIG. 16E**

waveform-shaped output

SC₂**FIG. 16F**

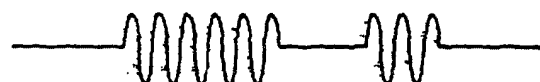
comand waveform

SC₃**FIG. 16G**

400KHz carrier

SC₄**FIG. 16H**

modulated waveform

SC₅**FIG. 16I**on side of appliance
to be operated
BPF(f₀=40KHz) output**FIG. 16J**

waveform-shaped output



FIG. 17

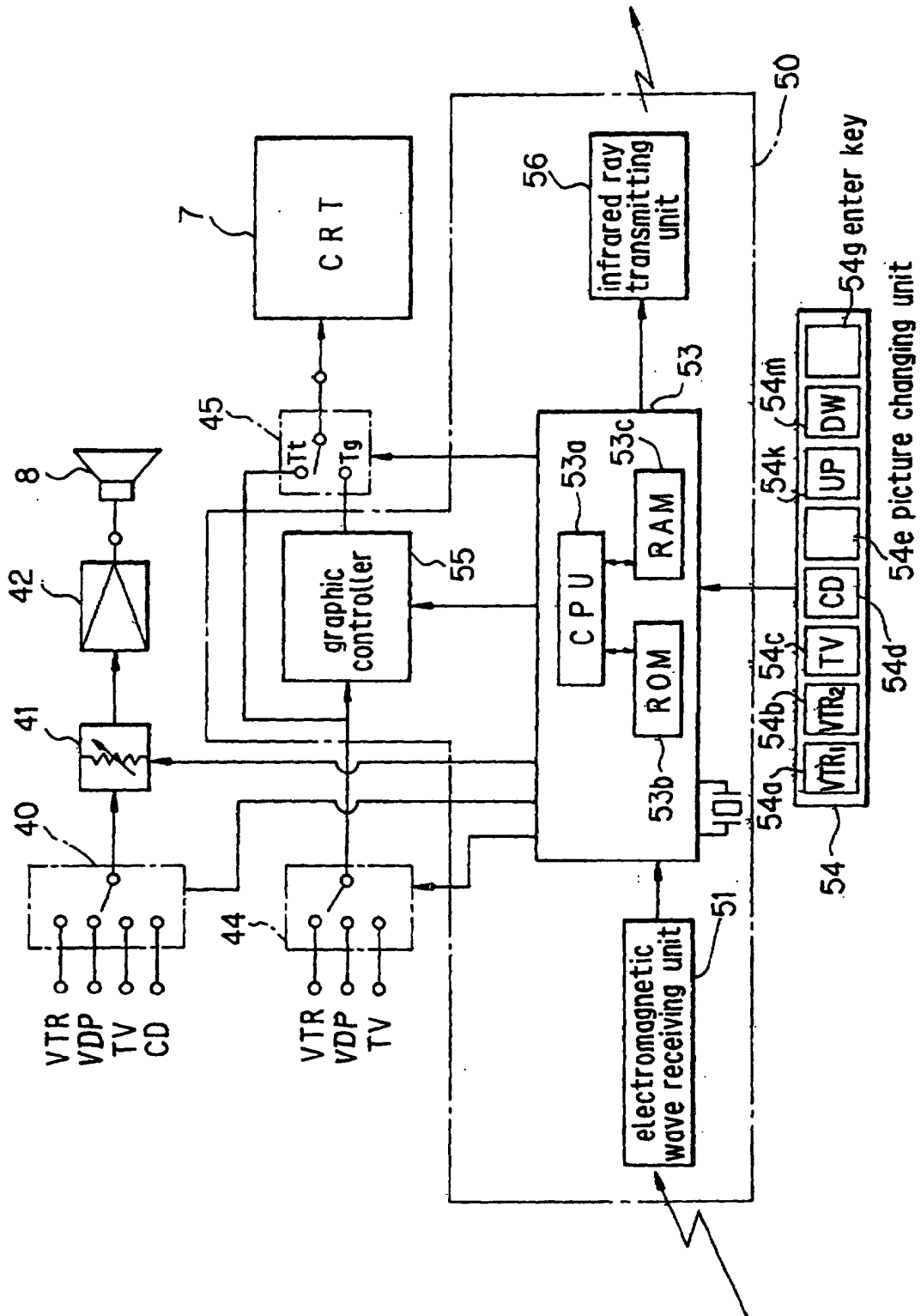


FIG. 18A

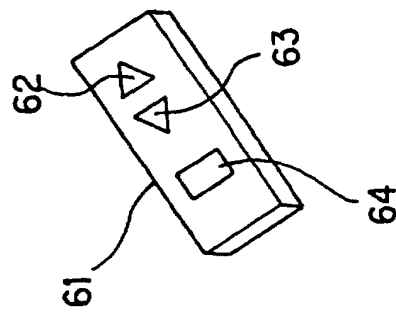


FIG. 18B

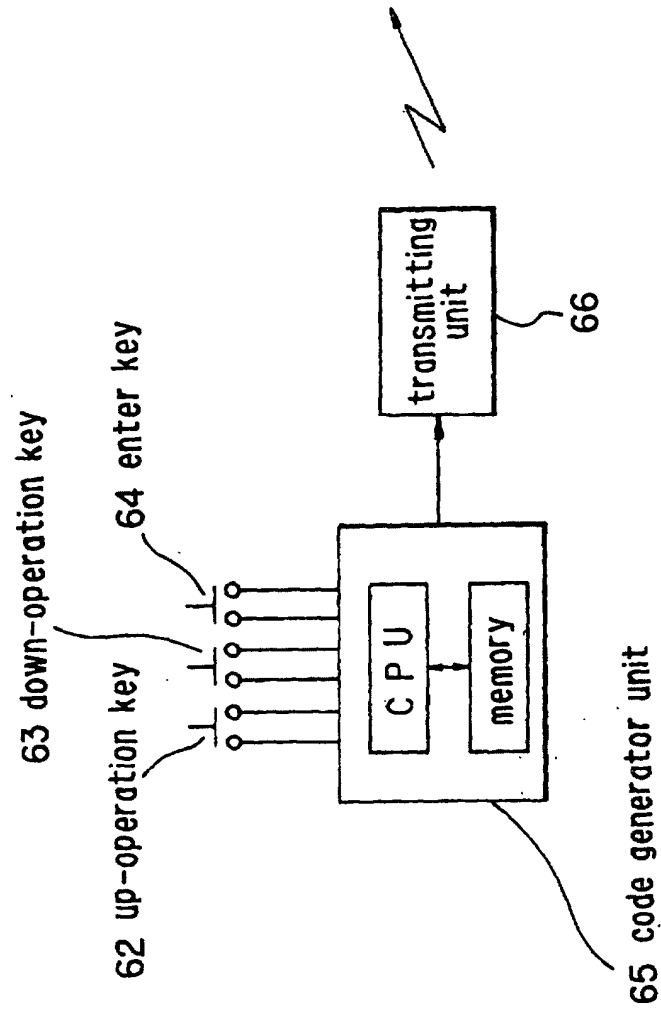


FIG. 19

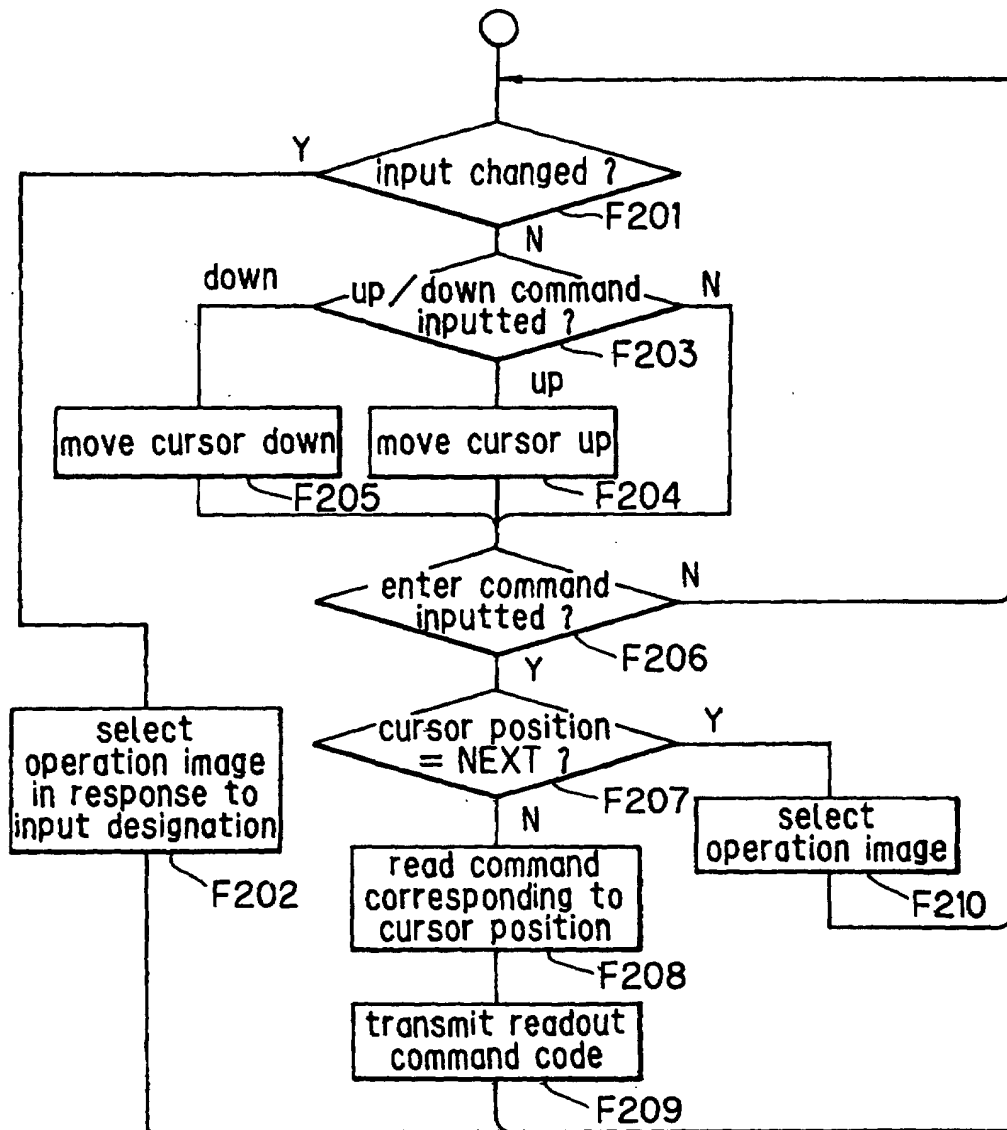


FIG. 20A

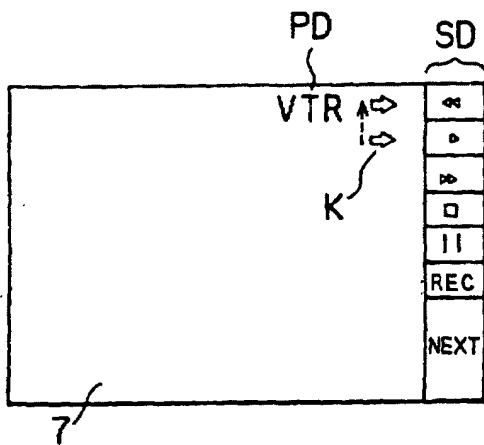


FIG. 20B

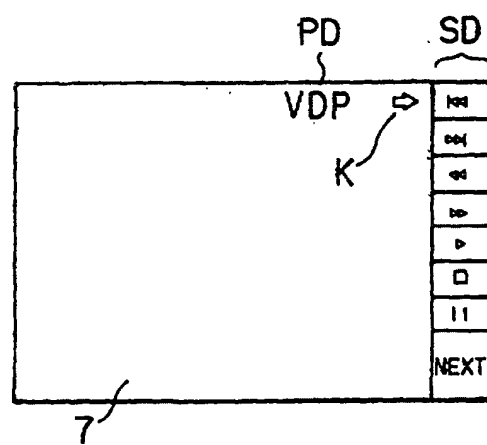


FIG. 20C

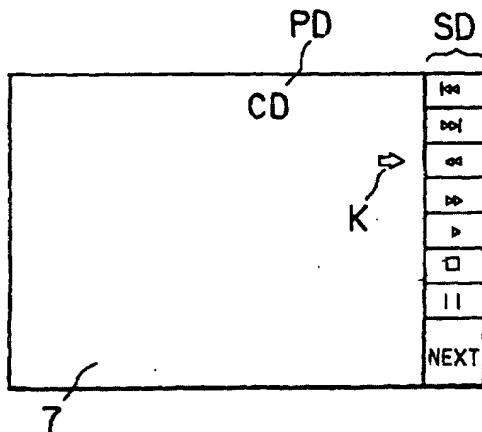


FIG. 20D

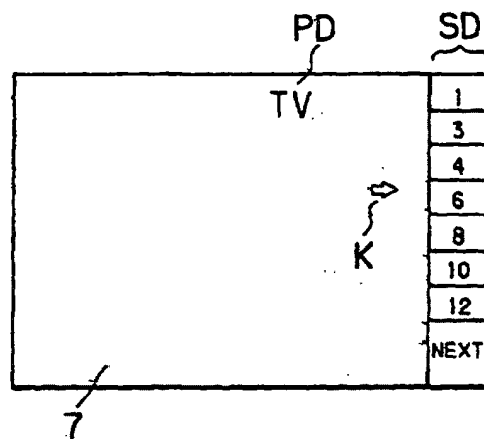


FIG. 20E

